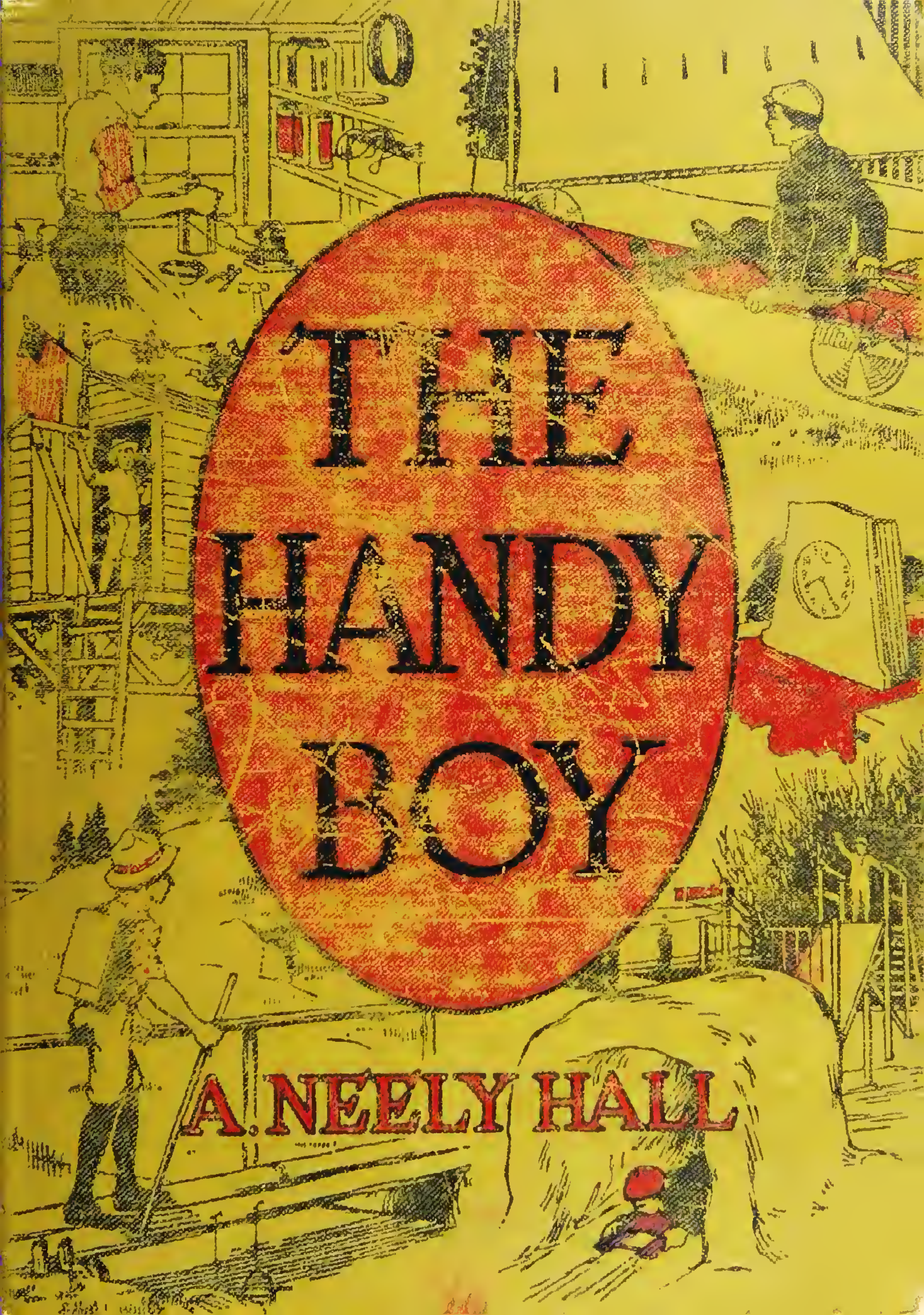
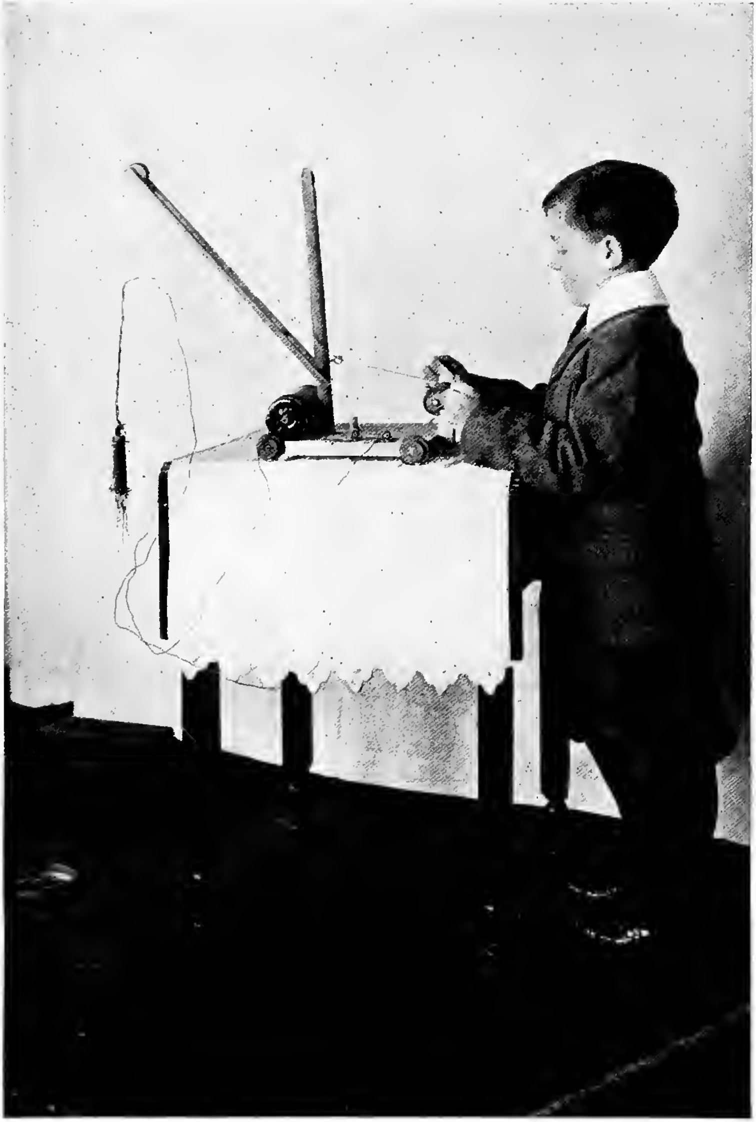

THE HANDY BOY
A. NEELY HALL

THE HANDY BOY



An Electro-magnet Derrick Hoisting a Load of 284 Brads.
(See page 151).

THE HANDY BOY

A Modern Handy Book of Practical and Profitable Pastimes

By A. Neely Hall

Author of "The Boy Craftsman", "Handicraft for Handy Boys", Etc.

With over six hundred illustrations and working-drawings by the author and Norman P. Hall

BOSTON

LOTHROP, LEE & SHEPARD CO.

Published, August, 1913.

THE HANDY BOY.

Norwood Press
Berwick & Smith Co.
Norwood, Mass., U.S.A.

Do Something and Be Something.

INTRODUCTORY NOTES

The handy boy becomes a handy man — a skilled mechanic, a practical business man, a thorough, accurate worker. That is why it is so important for a boy to learn to be handy, and why he should be encouraged in the pursuit of playtime pastimes which will develop handiness.

"The Handy Boy" has been especially planned with a view to training the boy in the ways of doing things handily, by applying handy methods to the making and doing of hundreds of worth-while things in which he will be intensely interested. Such instruction as it contains can be put to immediate use, and that naturally will appeal more to the boy's sense of the practical than instruction which he could not possibly use for years to come, and will be of infinitely more value to him because knowledge once applied is not easily forgotten.

Handiness comes more naturally to some boys than to others, but any boy who will employ a portion of his spare time to experimenting, and to working out handy boy ideas, can acquire it. Clumsiness is simply a lack of the knack of doing things gracefully, and the boy with a tendency to be clumsy must overcome it by properly applying himself.

The man of today who excuses his inability to do this or that by admitting that he is not handy, was one of the boys of yesterday who did not bother about making kites, constructing conveniences for the house, and building boats, wagons, tree-huts, and the like. Perhaps he had a good time, but he might have had just as good a time doing something useful, and would now have the enjoyment of making the things he would like to make if he but knew how. Many boys of today are growing up with no desire to do more than what is prescribed for them to do, who, with the right kind of encourage-

ment and suggestion might become handy men of tomorrow, prepared to do something and be something worth while.

Besides developing a boy's handiness, "The Handy Boy" will train him to think for himself and to use his ingenuity, and will instill in him an ambition to make the best possible use of his time always.

The suggestions contained in "The Handy Boy" have been selected after much study into what boys most enjoy making and doing, a knowledge of which the author has gained through many years of working with boys, and through corresponding with many of the hundreds of thousands of readers of his handicraft articles published in newspapers in every part of the United States and Canada, of his handicraft articles published in *The Ladies' Home Journal, Woman's Home Companion*, *The Delineator*, *Good Housekeeping*, *The Ladies' World*, *Technical World Magazine*, and the juvenile publications, *The American Boy, Boys' Magazine, Boys' World*, and *Youth's World*, and of his handy books, *The Boy Craftsman*, and *Handicraft for Handy Boys*.

There is woodworking, electrical and mechanical toy making, camp craft, and other forms of indoor and outdoor handicraft in "The Handy Boy," and, as in *The Boy Craftsman* and *Handicraft for Handy Boys*, the material at hand is used wherever possible in all constructive work, while suggestions are provided by which whatever money is needed for tools and materials may be earned. Thus the handy boy through "The Handy Boy" is encouraged to depend upon his own resources.

A. N. H.

OAK PARK, ILLINOIS,
May 31, 1913.

PART I

AUTUMN AND WINTER PASTIMES

CHAPTER I

CHAPTER II

CHAPTER XXX

LIST OF HALF-TONE ILLUSTRATIONS

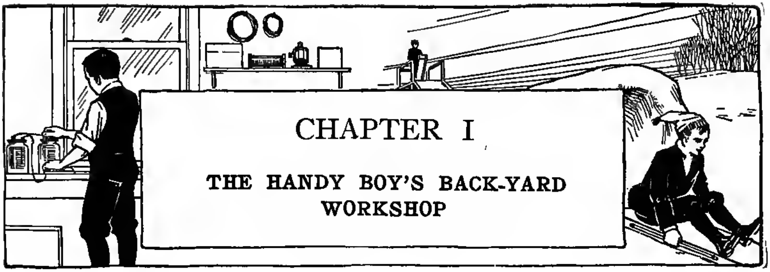
(In addition to nearly 600 text illustrations.)

PART I

PART II

PART I

Autumn and Winter Pastimes



CHAPTER I

THE HANDY BOY'S BACK-YARD WORKSHOP

THE handy boy should have a handy working-place for home carpentry and experimental work. What is needed is a corner somewhere for his work-bench, tool-chest or tool-cabinet, materials, miscellaneous apparatus, and models. Some boys have splendidly equipped basement workshops; others have equally as good attic workshops; some are allowed a spare room in which to work; some discover corners of the garage, barn, woodshed, and other buildings that are ideal locations; and many, either through lack of any suitable place, or through preference, build themselves workshops in the back yard. Different conditions make different locations necessary, of course, and every boy must meet the conditions as he finds them.

There are many suggestions for fitting up the home workshop in "The Boy Craftsman" and in "Handicraft for Handy Boys," and other ideas will be found in the following chapter. Neither of the former handy books, however, shows how to build a workshop from the foundation up, and so, as requests have been received from readers for a set of workshop plans, I am describing in this first

chapter of "The Handy Boy" the construction of a small building. A great many of you boys will not be able to build a shop at present, perhaps; but the workshop plans should be studied, no matter if not for immediate use, because every handy boy should be familiar with the proper method of erecting a small frame building. Maybe you will not need to draw upon this knowledge until some years later; but more likely than not you will at some time have occasion to build a hen-house, summer cottage, boat-house, or garage of similar construction, and if you know how to do the work yourself you will save a great deal of money. Besides, you will have an opportunity to demonstrate your ability as a handy-man.

A workshop structure need not be of elaborate design, nor of proportions larger than are necessary to house your bench and other equipment, a small stove, and provide comfortable working-space. You can get along with a shop which measures 8 feet square inside, with 6 feet 6 inches head-room at the lowest point; and the material required for such a shop will not make the construction expensive.

Building Material. New lumber is not necessary. Second-hand lumber can be purchased cheaply, and often it can be had for the cost of hauling it away, where a building is being wrecked or altered, and the building contractor is anxious to get it quickly out of his way. With a little watchfulness, you may uncover such a bargain in your vicinity.

Second-hand lumber is. not as easy to handle as new

material, and it requires some little time to separate pieces that are nailed together, and to withdraw nails; but the extra work is well worth while, considering the saving in the cost. The best preserved material can be sorted out for exposed places, and all of the remainder that is usable

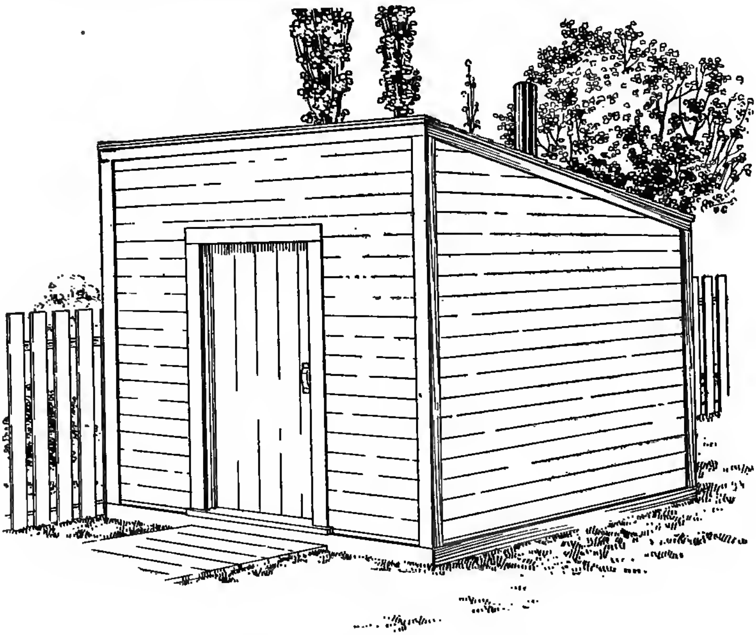


FIG. 1. — A Back-Yard Workshop with a Lean-to Roof.

can be placed on unexposed portions. Cut away broken, decayed, and badly cracked ends of boards that are to be used upon the outside, and carefully putty all the old nail-holes and cracks when you have nailed the boards in place. Then, when a couple of coats of paint are added, your little building will have a first-class appearance.

You must take into consideration the quantity of material at your disposal, in

Determining the Size of your Workshop; also the amount

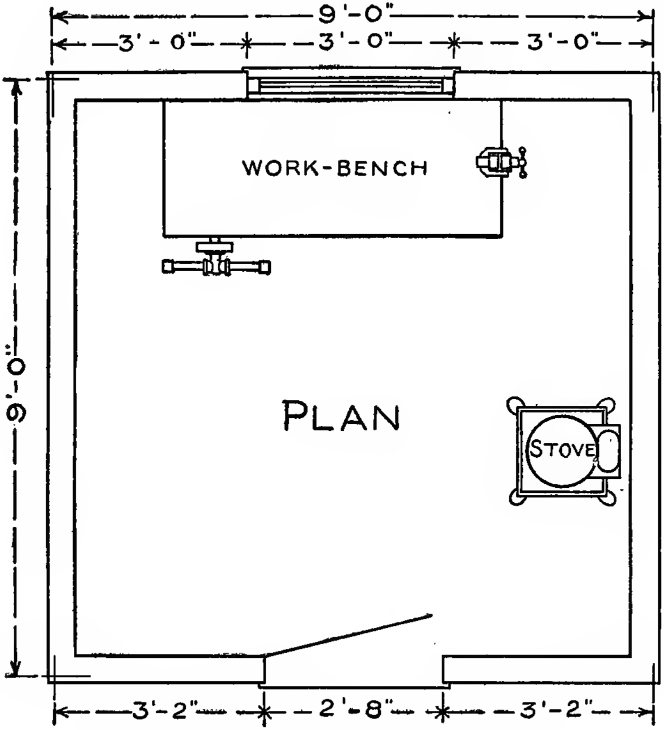


FIG. 2. — Draw your Workshop Plan Like This.

of ground space available. When you have located a place for the building, the first thing to do is to

Draw a Plan of the Workshop, just as you want it. This can be done with a ruler and pencil. Let every ½ inch upon the ruler represent 1 foot of the workshop; then your

plan will be drawn to a scale of ½ inch to the 1 foot.[1] Figure 2 shows a workshop plan. Draw the walls 5 inches thick, and indicate the door and window openings as shown. Also draw to the correct size the work-bench, the tool-cabinet, and the stove if you plan to have one, so that you will know just how much working space is left. Then draw a picture of the front of your building exactly to scale (the *Front Elevation*); also a picture of one side (the *Side Elevation*). If these drawings have been carefully made, you can now figure very closely how much material will be required for your building; that is to say, after you have studied over the following building construction and learned what material is required for a floor, walls, roof, etc. With a list of the material prepared, and carefully checked over to see that no mistakes have been made, it is a simple matter to estimate the amount of lumber needed. Then the size of the building can be reduced or enlarged upon, so the material will come within your cost limit.

Lumber is sold by the 1,000 feet (board feet). A *board foot* is reckoned as a piece 1 inch, or less, in thickness, 12 inches wide, and 12 inches long. Upon this basis a piece 1 inch thick, 4 inches wide, and 12 feet long contains 4 board feet, and a piece 2 inches thick, 4 inches wide, and 12 feet long contains 8 board feet.

Boards, studding, and other stock material, come in 10, 12, 14, 16, 18, and 20 foot lengths (pieces of greater length

[1] For further information about Working-drawings, see Chapter 5 of "Handicraft for Handy Boys."

are usually special stuff); and it is best to so plan your building that your boards, etc., can be cut up into two or three lengths with little or no waste. In buying, order the lengths that will cut up to the best advantage.

The workshop shown in Fig. 1 is of the simplest type of building, and its *lean-to* or shed roof requires less material and less time to build than any other kind. However plain this building is upon the outside, it will serve your purpose exactly as well as though it were of a more pretentious design. Vines trained over the sides will relieve their

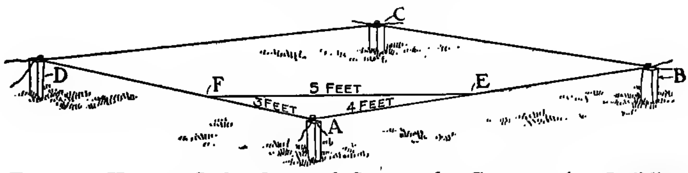


Fig. 3. — How to Stake Out and Square the Corners of a Building.

plainness, and make the little building an attractive addition to the back yard.

Staking Out the Workshop. The laying out of the workshop plan upon the spot selected for it must be done with care. The corners must be located exactly, so the opposite walls will be parallel, and so each wall will be at right angles to the walls adjacent to it.

The proper way of staking out a small building, when a surveyor's *transit* is not at hand, is shown in Figs. 3 and 4. First drive a stake into the ground at one corner of your building (*A*, Fig. 3), then another at an adjacent corner (*B*, Fig. 3). If the building is to run parallel to a sidewalk or a

fence, drive these stakes at equal distances from it. Drive a nail into the top of each stake to mark the exact corners, and connect the two with a cord. With a rule measure off as accurately as possible the positions for the other two corners, and drive stakes into the ground to mark them (*C* and *D*, Fig. 3). Connect *C* and *D* with a cord tied to nails driven into their tops, and run cords from *A* to *D* and from *B* to *C*. If you have made the opposite cords of equal length,

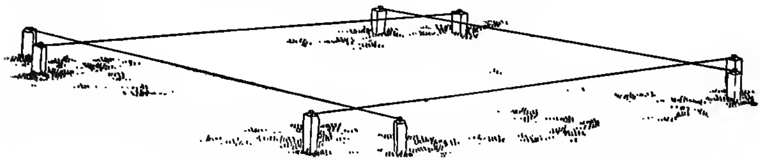


FIG. 4. — By Placing the Stakes as Above, they do not Interfere with the Framework Corners.

they will be exactly parallel; but the corners will not necessarily be right angles and must be corrected.

The Way to Test the Corners is by what is known as the *three-four-five rule.* Along the cord *AB* measure a distance of 4 feet from the nail in stake *A*, and at this point (*E*) tie a cord to cord *AB*. Also measure a distance of 3 feet along cord *AD*, from nail *A*, and hold the end of the cord tied at *E* over to this point (*F*). Now, if the angle formed by cords *AB* and *AD* is a right angle, the length of the cord between points *E* and *F* will be exactly 5 feet. The reason for this will be perfectly clear, if you have learned in mathematics the rule governing right-angle triangles — viz. the square of the *hypothenuse* (long side) equals the sum of the

squares of the other two sides. If you find that the angle is too great or not great enough, move stake *D* until by means of cord *EF* you prove that it is correct. In changing the position of stake *D*, be careful not to alter the length of cord *AD*. With the angle at *A* exactly right, it is necessary to correct only the opposite angle at stake *C*. Then you may be certain that the other two corners are right angles — that is, provided you know by checking up measurements that your lines are of the right lengths.

The cords represent the outside lines of your building; but, before starting the framework, it will be necessary to substitute other stakes for the corner stakes, as the latter would interfere with the framework. This is done by driving two stakes into the ground at each corner, in line with and about 12 inches away from the corner stakes (Fig. 4). Drive nails into their tops in line with those in the corner stakes, and then undo the lines, one at a time, and connect them to the new stakes. By lying flat upon the ground, and sighting across the tops of the stake nails, it is an easy matter to get the new nails exactly in line with those in the corner stakes; but it is well to test two opposite angles by the three-four-five rule, to be certain that you have not changed them. The original corner stakes can then be pulled.

The Foundation. If the soil on the site of your building is high and dry, and has not recently been disturbed (so there will be little chance of settlement), the floor of as small a building as your workshop may be placed directly

upon the ground surface; but if the ground is low and likely to be more or less damp, or is filled-in ground, the joist should be supported upon sills set on posts. Figure 5 shows this construction.

It is customary to set

Post Supports from 3 to 4 feet in the ground, so their bottom ends will extend below the frost line. If you haven't

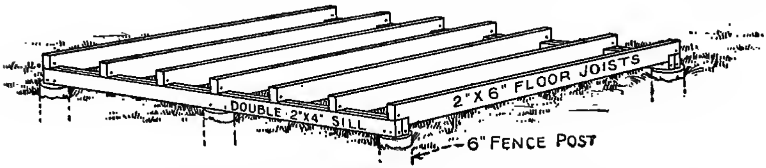


FIG. 5. — A Floor Constructed upon Sills that are Supported upon Posts.

a *post-auger* with which to dig post-holes, try the *two-shovel method of digging* described on page 69.

After digging the post-holes, and setting the posts in them, throw in the loose earth around them, and tamp it down solid with the end of a stick. The earth will pack better if you pour water in with it.

The tops of the posts should be sawed off square and level, to receive

The Sills. For a building 9 feet square the sills should be 4 inches wide and 4 inches deep, and be supported at each end, and at the center, on 6-inch fence-posts. Two 2-by-4s spiked together will do. After placing them on the post tops, rest a *level* on them and by means of chips of wood raise the low ends until the pieces are level. One sill must be on the same level as the other, also; so place a

straight 2-by-4 across each pair of ends, rest your level on the center of the length of these 2-by-4s, and, if one sill proves to be lower than the other, block up its ends. In case you do not have a carpenter's spirit-level, you can make and use a *home-made level* like the one shown in Fig. 151, page 68. *Toe-nail* the sills to the posts with 16-penny spikes (see *Toe-Nailing*, page 53).

Floor Joists. If the floor joists are 9 feet, or thereabouts, in length, 2-by-6s placed 16 inches on centers will support your floor; if the joists are much longer than this, use either 2-by-8s, or space the 2-by-6s 12 inches on centers.

The best method of fastening the joists to the sills is by notching their ends to fit over the sills, as shown in Fig. 5, and then toe-nailing them through the sides. Use 16-penny spikes for fastening together all material 2 inches thick. There is generally a slight variance in the widths and thicknesses of such stuff as 2-by-4s and 2-by-6s, and in notching the ends of the floor joists the depths of the notches should be varied accordingly, so as to bring all of the tops to the same level.

If the floor is laid directly upon the ground, as it is shown in Fig. 6, 2-by-4s placed flatwise will be sufficient for sill plates, and 2-by-4s can be used for floor joists. Notch the joist ends to fit over the sill plates, as shown.

Lay the Floor Boards as soon as you have spiked the floor joists to the sills. This will give you a solid platform to work upon. Six-inch *matched flooring* is best. In laying these boards, do not drive them very close together, as

allowance must be made for *swelling* to prevent any possibility of the floor *buckling*.

The Wall Framework. The usual way of constructing

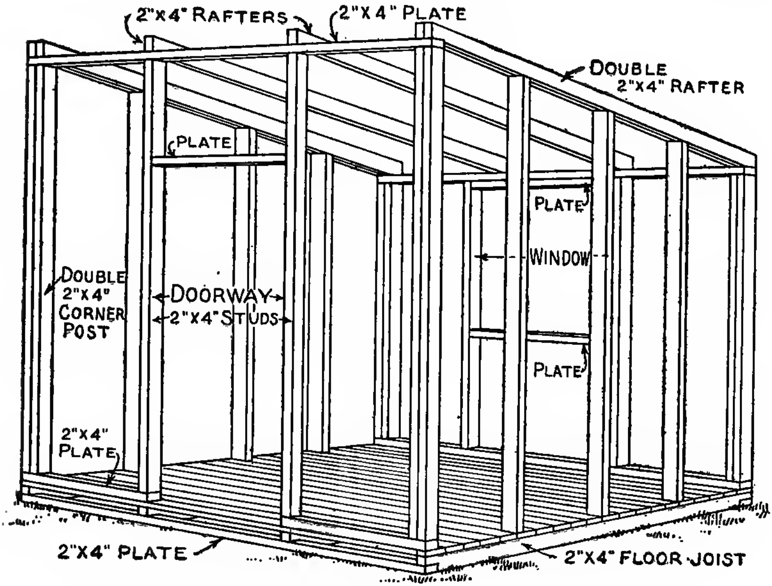


FIG. 6. — The Framework of the Workshop Shown in Fig. 1.

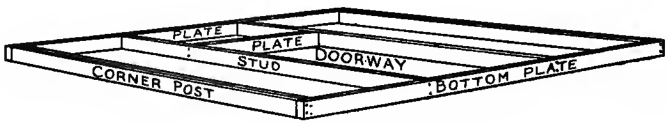


FIG. 7. — Put Together the Wall Framework Flat upon the Finished Floor.

the wall framework of one-story buildings, is to put together the framework of one wall flat upon the floor (Fig. 7), raise it into position, and brace it temporarily (Fig. 16);

then make a second wall and raise that into position; and so on, until all four walls are in place. Then the frames are *plumbed* and fastened together. The floored-over joists make a splendid platform on which to build up these frames.

For a small building with a lean-to roof, such as is shown in Figs. 1 and 6, it is best to make the front and rear wall frames in this way, and then set up the side wall *studs* after the roof rafters have been put on, fitting them between the floor and the rafters.

If your building is 9 feet long, and you make the head-room at the rear of the shop 6 feet 6 inches, the ceiling height at the front should be 2 feet 6 inches, or 3 feet, higher than this, to give the roof its proper *pitch*. Make the front frame this much higher than the rear wall frame.

Use 2-by-4s for the *wall studs*, the *corner posts*, the *top* and *bottom plates*, and the *plates* above the doorway and above and below the window opening. Figure 7 shows how the front wall frame is put together. The bottom plate is extended across the doorway, then sawed through and removed after all the framework has been put up (Fig. 6). Test each corner of the frame, as you fit the pieces together, to be sure that it is square; then nail strips across the corners, as shown in Fig. 16, to prevent the frame from twisting out of shape. Leave these diagonal braces in place until all of the framework has been put in place and fastened.

Plumbing the Framework. As soon as a wall frame has been raised into position, it should be *plumbed* vertically

before the braces are nailed in place. One end of each brace can be fastened, and the nails in the other started; then plumb one end of the frame and nail the brace to it, then the other end. It will be easiest to have some one fasten the braces while you attend to plumbing. The making and handling of a *home-made plumb-board* is described on page 68 and shown in Fig. 150.

The Roof Rafters are spiked to the top plate of the front and rear wall frames. Double the end rafter as shown in

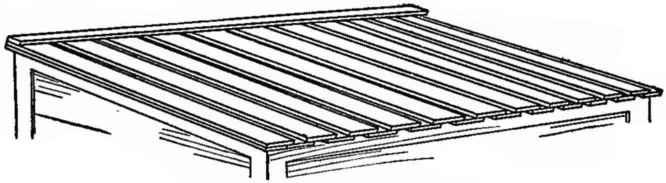


FIG. 8. — A Good Board Roof.

Fig. 6. The ends of the rafters should be trimmed to fit the plates.

The Roof Boarding. If the roof is to be shingled or covered with composition roofing paper, or metal, lay the roof boards across the rafters, placing them about 1 inch apart, as shown in the shop interior photograph (Fig. 17). It is very important to leave this much space between the boards if you shingle the roof, so the air will reach the under side of the shingles and dry them out after rains. Use 6- or 8-inch common pine for these boards.

A Covering of Boards laid in the same direction that the rafters run, and spaced about 3 inches apart, with a second layer of boards laid over the openings between

them, makes a good roof, and it is a covering that can be put on quickly (Fig. 8). To provide supports for these boards, it is necessary to fasten *purlins* between the rafters as shown in Fig. 9.

Shingling. Four ¼-thousand bunches of shingles will cover approximately 1¼ *squares* of roof, if laid with 4½

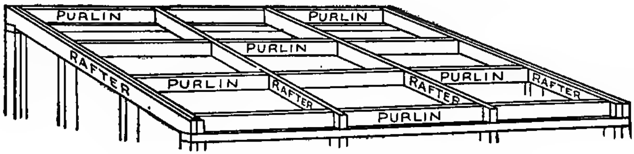


FIG. 9. — How to Frame a Board Roof.

inches of their surface exposed to the weather. A *square* equals 100 square feet, or a space 10 feet square. The first row of shingles along the lower edge, or *eaves*, of the roof should be laid double thickness, with the upper layer lapping the joints of the lower layer; and the shingles of each succeeding row must overlap the joints between the shingles of the preceding row.

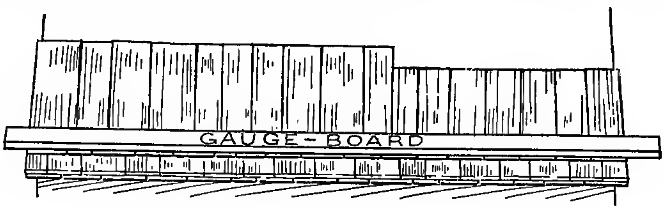


FIG. 10. — Gauge-Board for Laying Shingles.

Project the first row of shingles 1 inch or so beyond the wall of the building, and project the shingles the same

distance over the side walls. A board 4½ inches wide should be used as

A Shingle Gauge-Board for getting the edges of the shingles in straight lines (Fig. 10). As soon as the first double row of shingles has been laid, tack this gauge-board to it, with one edge even with the lower edge of the shingles; then lay the edges of the next row of shingles against the upper edge of the board. Move this board from row to row until the entire roof has been shingled. Cover the upper ends of the top row with a board and the roof will be completed.

Tar-Paper makes a good roof covering that can be put on cheaply. The paper should be laid across the roof, with the layers lapped the same way as in shingling, except that a lap of 3 or 4 inches is sufficient. Fasten the paper with *roofing-nails* and *tin-caps* (See Fig. 61, page 56). The tar-paper will be plenty good enough without daubing it with tar.

Boarding up the Walls. The framework may be boarded up, or *sheathed*, with *matched flooring*, *ship-lap*, *drop-siding*, or *beveled-siding* (Fig. 11). The only difference between *flooring* and

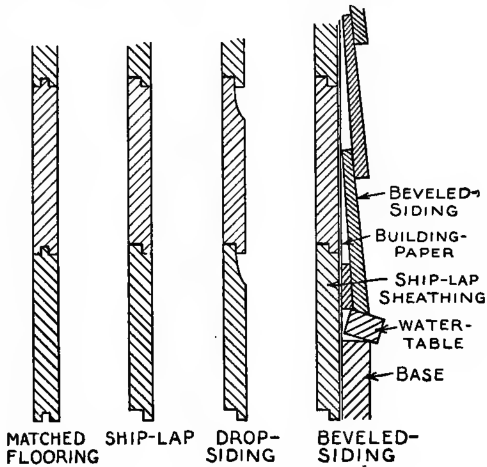


FIG. 11.

ship-lap is in the edges. Flooring has a *tongued* and a *grooved* edge, and ship-lap has two *rabbeted* edges. Ship-lap is more generally used than flooring for sheathing. *Drop-siding* differs from ship-lap in the shoulder of the upper rabbet, which is beveled off instead of cut square. This makes a neater covering than drop-siding, of course, for an exposed surface. *Beveled-siding* is described on page 26.

When two thicknesses of boards are used, to insure greater warmth, it is customary to put on ship-lap or matched flooring, first, then to tack *building-paper* over this, and fasten drop-siding, beveled-siding, or shingles on top of the paper. Before the second covering is put on, however,

The Door and Window Frames must be set in place. Suggestions for these will be found upon page 23.

The Outside Trim must be put on, also, because the siding or shingles must be fitted between the *trim*. The shop shown in Fig. 1 has a wall covering of drop-siding, while the shop in Fig. 12 is first sheathed with ship-lap, then covered with heavy building-paper, and then sided with beveled-siding placed on top of the paper. The building-paper should be lapped around the corners, and fitted close against the door and window openings; then the outside trim should be nailed in place, and the beveled-siding cut to fit between the trim.

Use 6-inch boards for the outside trim, and run them around the base, up each corner, around the walls just below the roof boarding, and around the door and window

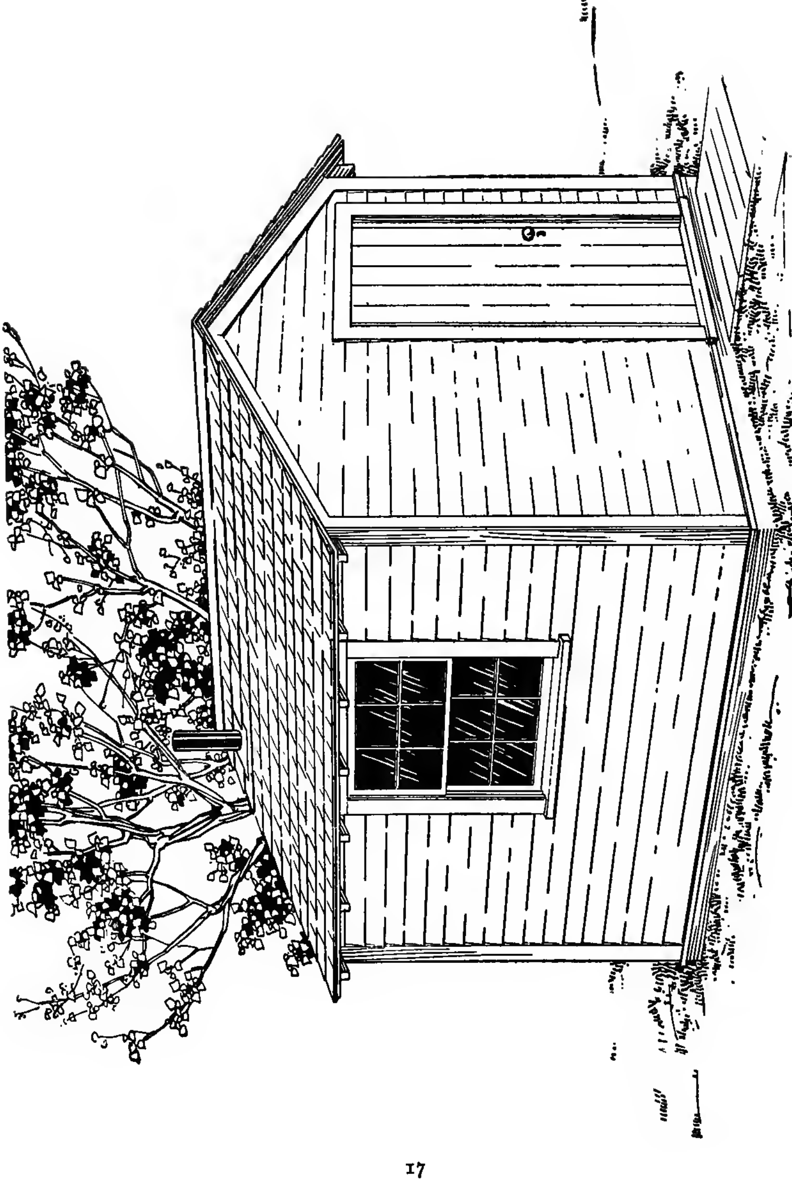


FIG. 12. — A Back-Yard Workshop with a Gable Roof.

openings. If siding is to be put on, a cap must be fastened on top of the base-board, for a *water-table* (Fig. 11). This strip must be beveled on top so as to shed water. The bottom strip of siding should be fitted on to this water-table.

A Workshop with a Gable Roof (Fig. 12) has more style to it than one with a lean-to roof, and

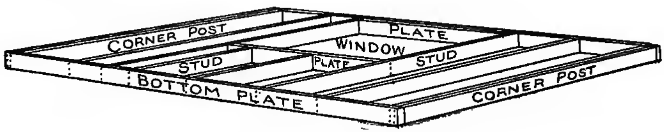


FIG. 14. — The Side Wall Framework.

The Framework, other than that of the roof, differs very little in construction (Fig. 13). The floor is framed and floored over, first, then all four walls are built up on the floor, one at a time (Figs. 14 and 15), raised into position, and braced (Fig. 16). The ends of the top plates are *halved*, so that the *end plates* can be lapped over the *side plates* and

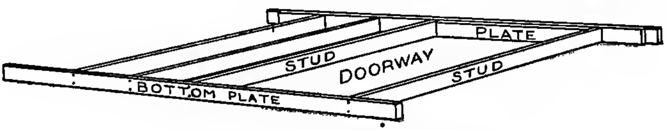


FIG. 15. — The End Wall Framework.

be spiked to them (Fig. 16). The *halved-joint* consists in cutting away from each end of the plates one-half of their thickness, for a distance equal to the width of the adjoining plate. The studding in this framework is spaced 16 inches on centers, except where door and window openings occur, where the spacing is varied as shown in Fig. 13.

FIG. 17.—INTERIOR OF WORKSHOP SHOWN IN FIG. 12.

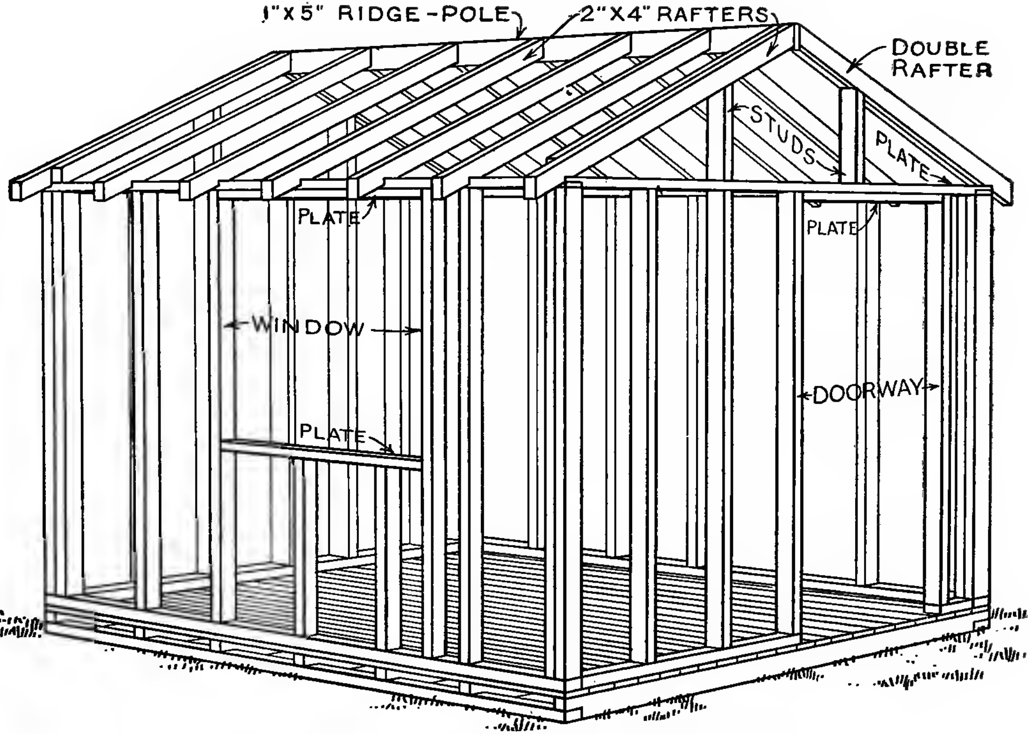


FIG. 13. — The Framework of the Workshop Shown in Fig. 12.

To Determine the Pitch of the Roof. The roof construction is shown in detail in Figs. 18, 19 and 20. The first thing to determine is the *pitch* of the roof. The *pitch* is the proportion obtained by dividing the height to which the roof rises, into the *span* (the distance between the rafter supports). Thus, in a building 9 feet wide, with a roof which rises 2 feet 3 inches, the roof has a *¼-pitch.* A roof

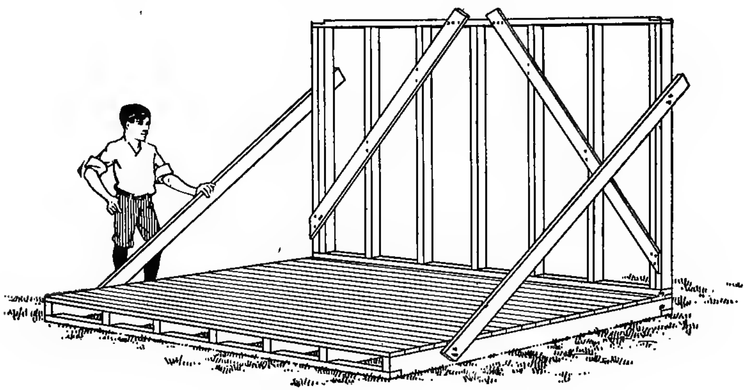


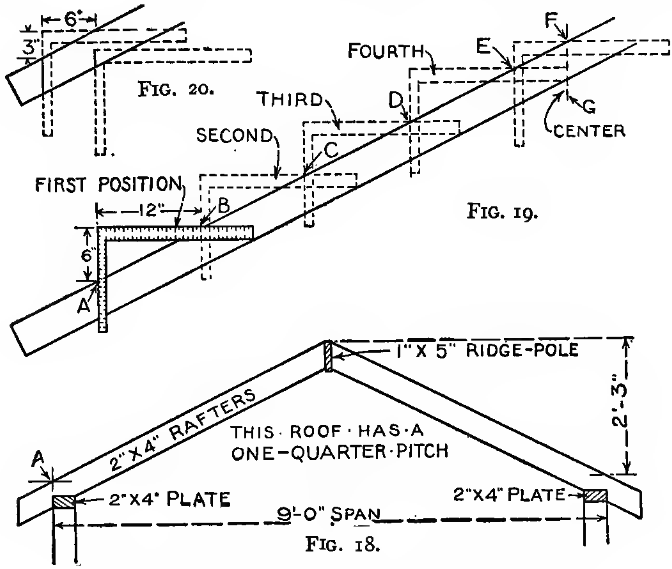
FIG. 16. — How the Wall Framework is Raised and Braced.

which rises 3 feet with the same span of 9 feet would have a *⅓-pitch;* if 4 feet 6 inches, a *½-pitch.*

When you have decided upon the roof's pitch, it is an easy matter

To Lay Out the Length of the Rafters, and cut off their ends at the proper angles to meet the *ridge-pole* and wall plates. The method of laying out the rafters for a ¼-pitch roof is shown in Fig. 19. A carpenter's steel square is necessary. Starting at the point *A*, which is far enough from

the end of the rafter to allow for the overhanging eaves, place the square upon the rafter with the 6-inch mark on the *tongue* (short end of square) at *A*, and the 12-inch mark on the *blade* (long end of square) at *B* (see "First Position," in Fig. 19). Mark these points on the rafter, then



FIGS. 18–20. — How to Lay Out Gable-Roof Rafters.

move the square along the rafter until the points *A* and *B* come at *B* and *C* (see "Second Position"); then move it to the points *C* and *D* ("Third Position"), then to *D* and *E* ("Fourth Position"). You have now measured up 2 feet, which is 3 inches lower than the peak of the roof, and horizontally 4 feet, which is 6 inches short of the center of the building. To locate the point upon the rafter which

will be both the peak of the roof and the center of the building, slide the square up until the 3-inch mark on the tongue of the square comes at *E*, and the 6-inch mark on the blade comes at *F*. The point *F* will be the center of the building. Square the line *FG* across the rafter, as shown. Saw off the rafter ½ inch inside of line *FG*, to allow for the thickness of the ridge-pole (see Fig. 18).

The lower end of the rafter is notched to fit over the wall plate. Figure 20 shows how to lay out this cut with the steel square; also the way to lay out an eave projection of 6 inches.

The Ridge-Pole is used to simplify the matter of fastening the upper ends of the rafters, and it should be a board 1 inch thick and 5 inches wide. Before

Putting Up the Rafters, lay boards across the top wall plate for a scaffolding to stand upon. Spike the rafters at one end of the building to the ridge-pole, first, then those at the opposite end, and then the intermediate ones. Double the end rafters with a second rafter (Fig. 13).

Window-Frames. A window-frame with *weight-boxes, sash, glass, sash-cord,* and *weights,* for a small window opening, will cost about $3.00. If you cannot afford to pay out this much, you can get a couple of window-sash for about $1.50, and make your own frame, either with a weight-box, or without. Weights are not necessary, though very convenient, because you can nail the upper sash in place, and fix the lower sash to slide open sideways, or hinge it to swing open. When the author built a back-yard work-

shop, when a boy, he found a couple of old sashes, made his own window-frame, fastened the upper sash permanently and made a side pocket for the lower sash to slide into.

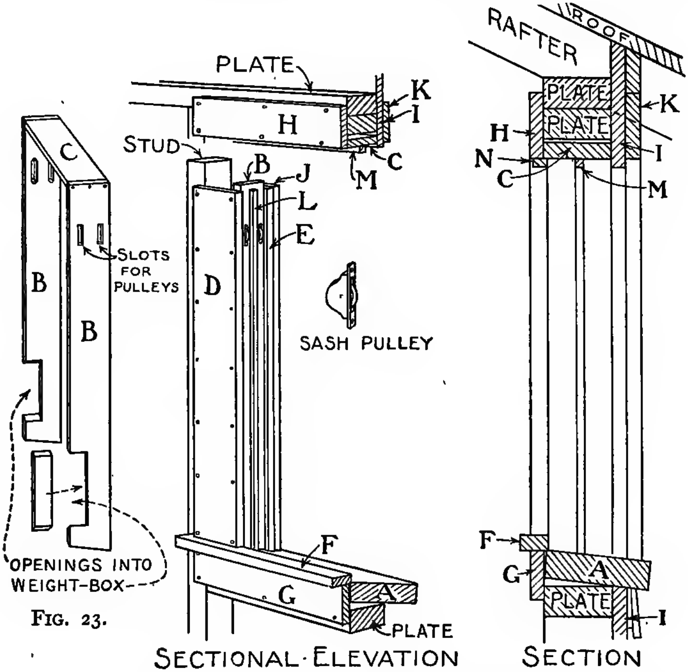


FIG. 23. FIG. 21. FIG. 22.

FIGS. 21–23. — These Details Show How to Construct Window-Frames if you Cannot Buy Them.

This proved to be a very satisfactory arrangement.

Figure 21 shows a sectional elevation of

A Home-Made Window-Frame and Weight-Box that is not difficult to put together. Figure 22 shows a section through the building wall with the frame in place. The

sill (*A*) is a piece of 2-by-8 cut to fit between the studs at the sides of the window opening; its inner edge is set even with the inside face of the studs, and the outer edge projects beyond the outside face of the walls. The sill is tilted slightly to shed rain water. Figure 23 shows how to start the frame. The pieces removed from the inner edge of the *jamb* boards (*B*) are sawed out on a bevel, so they can be fitted back into place. These openings provide a means of getting at the weight-boxes to repair sash-cords. The upper slots are cut to receive the *sash-pulleys*. The distance between the jambs of the frame (*B*) and the stud each side of the frame, must be at least 2½ inches, to allow plenty of room for the sash-weights. The boards *D* and *E* form the inside and outside walls of the weight-box, and if the workshop is not plastered or boarded up on the inside, board *D* will also do for the *window-trim*. Nail boards *D* and *E* to the window-frame, and to the stud back of the weight-box. Board *F* is the *window-stool*, *G* is the *apron*, and board *H* is the *head trim*. *I* represents the outside *sheathing*, and *J* and *K* the *outside window trim*. *L* is a strip ½ inch square, which separates the two sashes at the jambs, and *M* is a continuation of the same strip across the window head. *N* is the *window-stop*, which holds the lower sash in place. This strip must extend down the jamb of the frame, also.

Sash-weights can be purchased from any hardware dealer. Each must be just a trifle heavier than one-half the weight of the sash, so as to balance it nicely.

A Door-Frame may be eliminated altogether, if you set your studding at the proper places for the door-jambs. Make a sill out of a piece of 2-by-6, and place it so the inner edge comes to about the center of the side studs. Then nail strips up each side stud, and across the head plate. These strips and the sill form *stops* for the door to strike against.

A Batten Door is plenty good enough. Figure 24 shows one hinged in place to the stud door-jamb. Build this door upon the floor. Make it of matched boards. Screw or nail the end battens in place; then cut the diagonal batten to fit between them, and fasten it in place. Be sure to run the diagonal in the same direction in relation to the hinged edge as is shown, so it will brace the door properly. Hinge the door with T-hinges (see Fig. 111, page 59; also Hinges and Hinging, page 58).

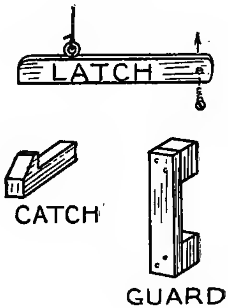
If you can get a *rim door-lock* (Fig. 25), fasten it upon the inside face of the door; if not, the old-fashioned

Wooden Latch and Latch-String will be plenty good enough, with a *hasp* (Figs. 115–117, page 59) fastened upon the outside to padlock when you are away from the shop. The *latch*, *catch*, and *guard* are shown in position in Fig. 24, and in detail in Fig. 26. The *latch-string* should be tied to a screw-eye or nail in the top of the latch, and should run up and through a hole bored through the door near the top; and a nut or some such thing should be tied to the outer end to catch hold of to raise the latch. The *button* shown screwed to the jamb stud is provided as a means of

locking the door from the inside. When this is turned down, the latch cannot be lifted.

Siding. This workshop building has its walls sheathed on the outside, then covered with building-paper, and then

FIG. 26.



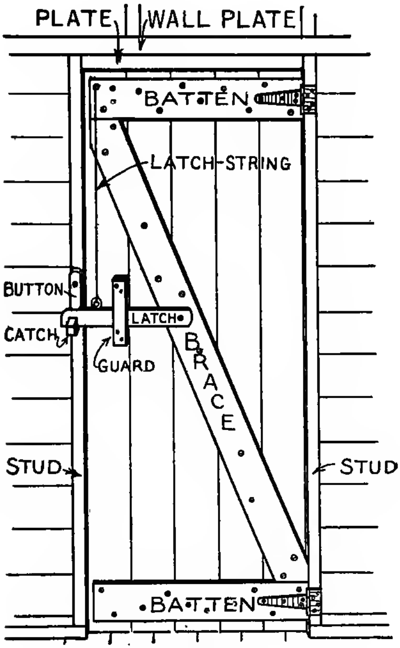


FIG. 24.

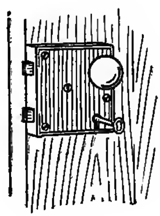


FIG. 25.

FIG. 24. — A Batten Door with Wooden Latch and Latch-String.
FIG. 25. — A Rim Door Lock for Inside Face of Door.
FIG. 26. — Details of Wooden Latch, Catch, and Guard.

with beveled-siding. The outside trim must be put on before the siding; and a wooden cap must be nailed on top of the base-board of this trim to form a *water-table*. Then

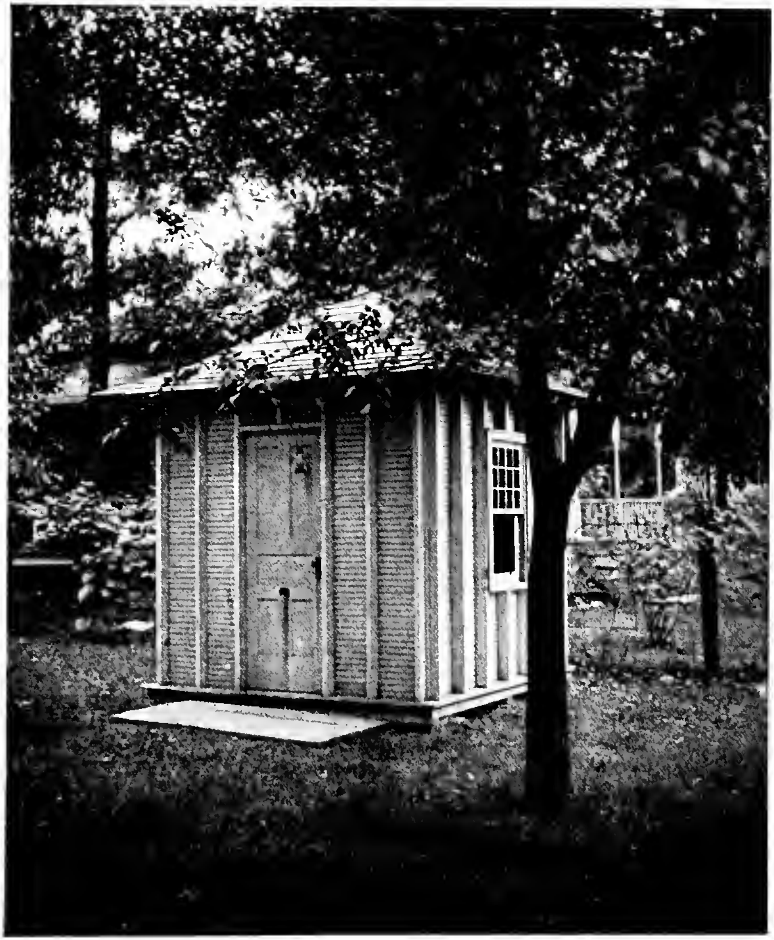


Fig. 27.—A Workshop with a Hip Roof.

the siding must be cut to fit between the trim boards, and be nailed in place. *Beveled-siding* (Fig. 11) comes 5½ inches wide, and is about ½ inch thick on one edge and beveled down to ¼ inch thick on the other edge. Siding of the above width is customarily laid with 4½ inches exposed to the weather, which allows a lap of 1 inch. A block of wood 4½ inches wide should be used for a gauge for getting the same amount of lap on each piece.

A Workshop with a Hip-Roof is more ornamental for a back yard than one with either a gable-roof or a lean-to roof (Fig. 27). A hip-roof involves considerable more time in its construction, for the reason that there are so many different lengths of rafters and different bevels to cut, all of which must be figured carefully. Such a roof is not difficult for one to frame who has had practical experience in carpentry, though it might be difficult for most of you boys, without help. Perhaps your father might lend a hand, if you want to put a hip-roof upon your shop, or perhaps he will get some one to help you. A carpenter could give you all of the assistance necessary in two hours' time.

A unique feature of the little building shown in Fig. 27 is the method in which the framework is boarded up. You will notice that this is done upon the inside of the studding instead of the outside, which makes a neatly sealed interior. Narrow, *matched-and-beaded ceiling* has been used. Ultimately, the exterior will be plastered with *cement stucco*, and this will be done easily, inasmuch as it will only be necessary to lath the studding with wood lath as a founda-

tion for the stucco. Instead of stucco, drop-siding or beveled-siding could be nailed on, of course.

The only difference between

The Wall Construction of this building and that of the workshop with the gable-roof is at the corners (Fig. 28),

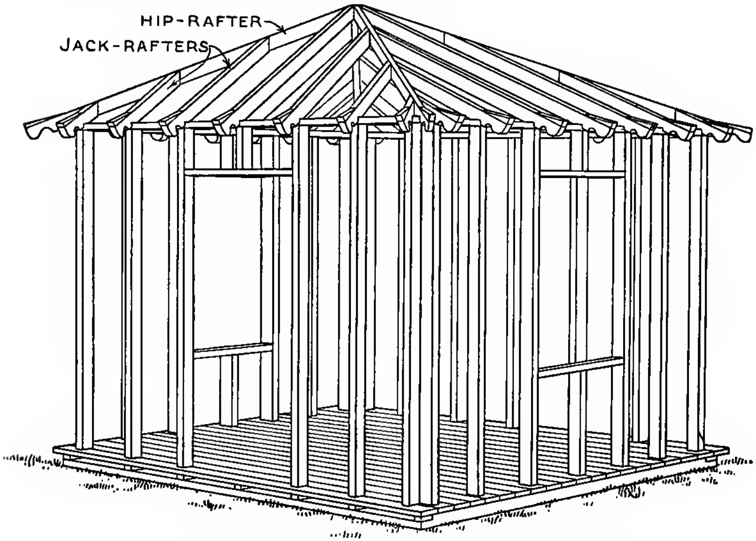


FIG. 28. — The Framework of the Workshop Shown in Fig. 27.

where, instead of a corner-post, two posts are set at right angles to one another, to furnish corner nailing surfaces for the inside boards.

The Roof Framing. The *hip-rafters*, and the center *jack-rafters* on each side, can be laid out by means of the steel-square method shown in Fig. 19. In the case of the hip-rafters, the distance across corners, diagonally, must be

taken as the *span*. The upper ends of the shorter jack-rafters can be located upon the hip-rafters, after the latter have been spiked in position, and the proper length and bevels can then be determined easily. The eave end of each rafter is curved to make it ornamental, and is blocked up on top with a triangular strip, to give a slight *kick-up* to the roof. This is shown in Fig. 28, and in the larger detail drawing, Fig. 29. The roof boarding must be beveled at the hip ends, and the shingles must be, also. Then a strip of tin or galvanized iron must be nailed over each hip, from the peak of the roof down to the eaves, to cover the joints between the shingles and make the roof tight. Paint this metal *flashing* with red-lead upon both sides, to prevent it from rusting.

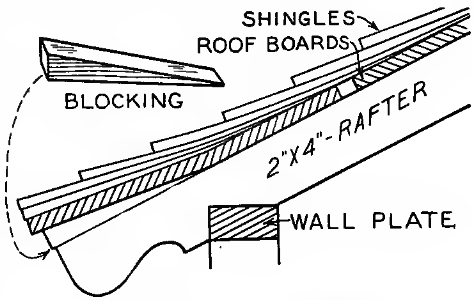


Fig. 29. — Detail of Rafter Ends.

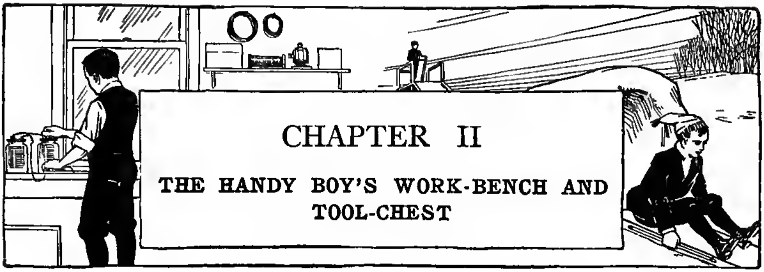
The under side of the rafters should be boarded with *matched-and-beaded ceiling* so the ceiling will match the walls.

Painting. The exterior of your workshop should be given two coats of paint — a *priming coat* and a *finishing coat.* The first coat may be of *white-lead*, or any light color. After it has dried, putty the nail holes. The holes will then be partly filled with paint, and the putty will stick better than

if pressed into dry holes. Whatever metal flashing has been used upon the roof should be given a coat of paint of the color used for the trimmings.

If you Install a Stove for heating your workshop, and extend a stove-pipe through the roof, or out through a wall, be sure to keep the pipe at least ¾ inch away from any wood, to eliminate any possibility of the wood catching fire. A tin *collar* must be cut to fit over the top of the pipe, to make the roof water-tight, and the roof shingles should be lapped over its edges just the same as though the piece of tin were a shingle (Fig. 12). Fasten a second tin collar around the stove-pipe, close against the workshop ceiling, and tack it in place. Protect the floor, beneath the stove, with a piece of heavy galvanized iron large enough for the stove legs to stand upon (Fig. 17).

Be very careful to keep shavings from accumulating around your stove, and do not allow oily rags or waste to remain outside of covered cans, for when exposed to the air in a warm place there is always danger of them catching fire spontaneously. Keep bottles of benzine and turpentine corked, and as far away from the stove as possible.



CHAPTER II

THE HANDY BOY'S WORK-BENCH AND TOOL-CHEST

Every handy boy — whether his hobby be carpentry, mechanics, or electrical work — requires a home work-bench. If there isn't a portion of the basement or attic in which you can fit up a permanent shop, and if you cannot build a back-yard shop like one of those described in Chapter I, probably you can find a corner somewhere large enough for the bench. Even if you live in an apartment building, you can probably get permission to use a corner of the basement. Sometimes, the apartment building storeroom is large enough, and if there is an outside window opening into it, and the stored articles can be piled up to one side, it will serve the purpose excellently.

A Home-Made Work-Bench will be just as practical as a bought one, and the difference between the cost of its construction and the cost of a ready-made bench can be expended to better advantage for tools.

For the bench shown in Fig. 30, 2-by-4s should be used for the legs, 4-inch boards for the braces and rails, 2-inch stuff 8 inches or 10 inches in width, for the bench-top, and a piece of 2-by-8 for the jaw of the vise. If you know a carpenter, he will probably be willing to do your purchasing for you; or, if there is a building in course of construction in your

neighborhood, you can probably get such material as you need from the carpenter foreman on the job.

The bench illustrated is 5 feet long, 24 inches wide, and 2 feet 8 inches high. These dimensions may be altered to

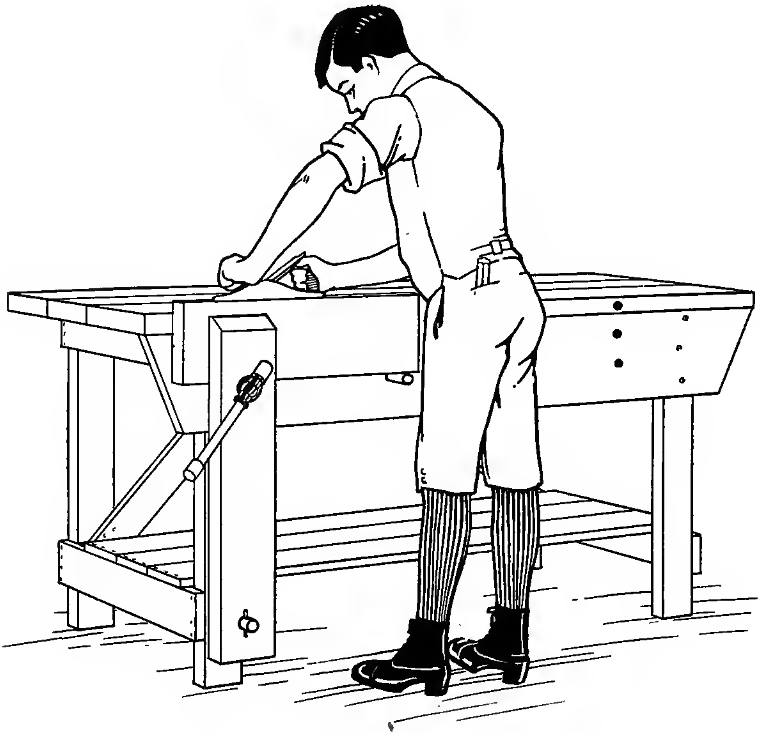


Fig. 30. — A Handy Boy's Work-Bench.

suit your working space. If you are short, and you find the bench too high, you can saw off the ends of the legs as much as is necessary to make it of a comfortable height.

The Framework. Cut the four legs (*A* and *F*, Fig. 31) 2 feet 6 inches long, the rails *B* and *C* 4 feet long, and rails G and H 23 inches long. Then place the legs *A* upon the floor, flatwise, and connect them with rails *B* and *C*, fastening *B* at the tops as shown, and *C* 4 or 5 inches above the lower ends. The frame thus made must be square at the

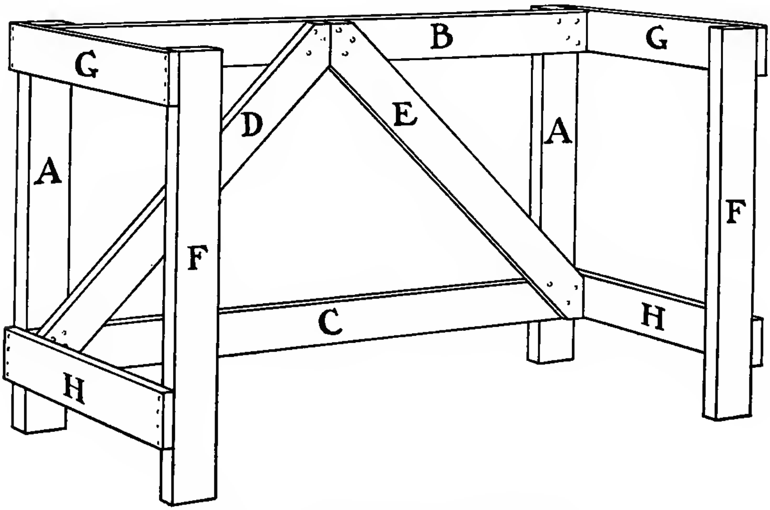


FIG. 31. — Framework of the Work-Bench.

corners, in order that the completed bench may be square; so, before nailing these pieces together, it is essential to test all four corners of the frame. The diagonal braces *D* and *E* should then be cut and fastened to rails *B* and *C* in the manner shown. Trim the corners of the pieces so they will fit as in the illustration.

The ends of rails *G* and *H* should be nailed to legs *F*, then

to legs *A*. When stood upon its legs, the framework should look like it does in Fig. 31.

Cut the *apron*, or wide board that extends across the face of the bench (Fig. 30), next, and fasten it to the framework (Fig. 31). This board should be 5 feet long, with the ends cut off on the diagonal, as shown; it may be cut from an 8-inch or a 10-inch board. Fasten it to the face of the front legs with an equal projection over each bench end.

Cut the bench-top pieces the length of the apron, and screw or nail them in place. The front edge of the first piece should be planed smooth, and should be placed even with the face of the apron so as to make a flush surface for the face of the vise.

The Bench-Vise. An iron *bench-screw* can be purchased at a hardware store for 50 cents, and with one of these in hand the construction of a good vise is a simple matter. The *jaw* of the vise should be about 2 inches thick, 8 inches wide, and of about the length of the legs. Nail it, temporarily, to the bench, directly in front of the left-hand leg, with the top about ½ inch above the bench-top. Then locate the hole for the bench-screw, and cut this hole through the jaw, the apron, and the leg. If your largest bit isn't large enough to bore this hole, bore a number of small holes, and then finish the cutting with a chisel (see Fig. 153, page 71). The hole should be made fully ¼ inch larger than the diameter of the screw, and it should be enlarged on the back of the leg as much as is necessary to receive the threaded *socket* that comes with the bench-screw (Fig. 32). Some

bench-screws are not threaded their entire length, and when this is the case it of course becomes necessary to block out the iron socket, instead of setting it into the leg; otherwise, it would not be possible to close the vise entirely. After the screw has been slipped through the hole in the jaw, the collar on the handle end should be screwed to the face of the jaw.

After attaching the bench-screw, bore a hole through the jaw, and through the bench leg, near the bottom of the jaw, for the *sliding-stick* to run through (Figs. 32 and 33). Trim off the top of the vise-jaw flush with the bench-top, and bevel off the face edge as shown in Fig. 33; then withdraw the nails with which you fastened the jaw to the bench.

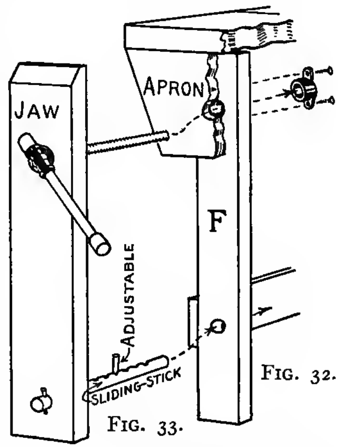


FIG. 32.

FIG. 33.

FIGS. 32 and 33.—Details of the Bench-Vise.

The Purpose of the Sliding-Stick is to guide the lower end of the jaw and keep the jaw vertical. In screwing shut the vise, the tendency is for the lower end of the jaw to push in, and then of course the upper portion does not grip the work squarely, but with the sliding-stick and peg arrangement, the peg can be adjusted to the proper hole to keep the lower end of the jaw directly under the upper portion.

A piece of a broom-handle 14 or 15 inches long will do

for the sliding-stick. Bore a number of holes through it ½ inch on centers, then fasten one end through the hole in the jaw, by means of a wooden or iron pin. A pin should be provided to fit the holes in the sliding-stick, and this must be adjusted for each different width of work to the proper hole to keep the jaw vertical.

Several holes should be bored through the work-bench apron, as shown in Fig. 30, and a peg should be cut to fit

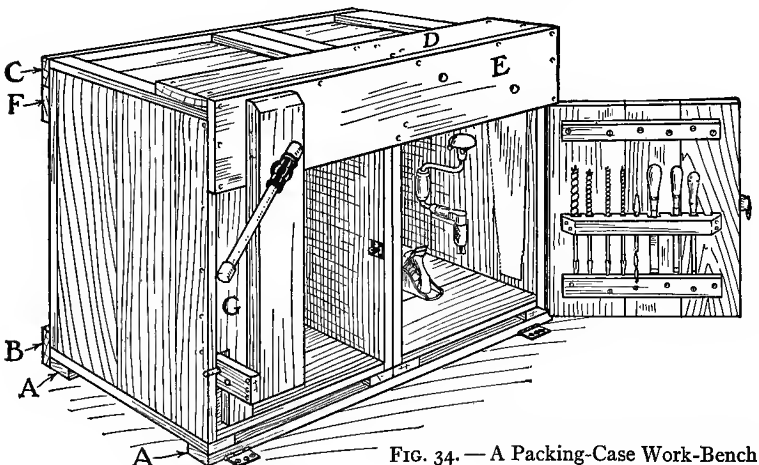


FIG. 34. — A Packing-Case Work-Bench and Tool-Cabinet.

them. The purpose of this adjustable peg is to support the end of long pieces of work placed in the vise.

A Packing-Case Work-Bench and Tool-Cabinet like the one illustrated in Fig. 34 is very easy to build, and, as it requires only two boxes which can be purchased for 15 or 20 cents apiece, a 50-cent bench-screw, and several lengths

of boards which can likely be picked up in the basement or woodshed, it should not cost over one dollar.

One box will do for a small bench, and be perfectly satisfactory for many purposes; but if you make a vise two

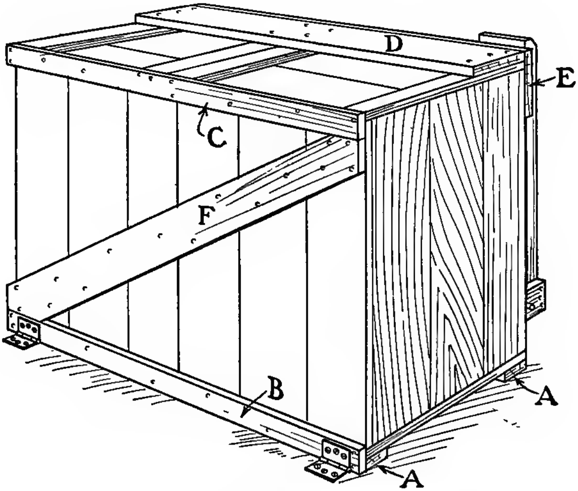


FIG. 35. — View of Back of Work-Bench

boxes will be needed. One large packing-case would make a good electrical work-bench.

The packing-cases should be about 20 by 20 by 30 inches in size for a bench similar to the one shown in Fig. 34. You can probably get boxes of this size from a near-by dry-goods store. The boxes should be of equal length. It will not matter if there is a difference in the widths, and if one is deeper than the other it can be allowed to project at the rear.

The first thing to do, after getting the boxes, is to reenforce them wherever boards show signs of loosening, by driving in additional nails. Then place them on end, as shown in Fig. 36, and connect them side by side with strips *A* upon the bottom (Figs. 34 and 35), with strips *B* and *C* across the back, with the board *D* across the top, even with the front, and with the apron board *E* across the front. Strips *A*, *B*, and *C* need not be more than 3 or 4 inches wide. Board *D* should be 10 or 12 inches wide, as it forms the main working surface of the bench, and board *E* should be of the same width, as it forms the surface against which work is held when placed in the vise.

Cut the diagonal brace *F* to fit between strips *B* and *C*, and nail it to the back of the bench. This board should run from the upper left corner of the bench down to the lower right corner, as shown in Fig. 35, in order to brace the bench properly.

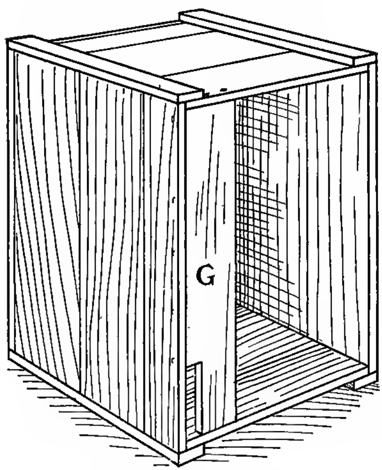


FIG. 36.—The Board G Forms a Pocket for the Vise Sliding-Strip.

The Bench-Vise is constructed at the left end of the bench. Cut the vertical board *G* to fit between the ends of the left-hand packing-case (Fig. 36), and, before nailing it in place, saw a piece 1½ inches wide and

6 inches long out of the lower end. This opening forms a pocket for the sliding-strip of the vise.

The vise-jaw should be 6 or 8 inches wide, 2 inches thick, and about 6 inches shorter than the height of the bench. The best way to bore the hole for the bench-screw is to nail the jaw, temporarily, to the front of the bench, in its proper position, with the top even with the bench-top, and then to bore straight through it, through the apron *E*, and through board *G*. The hole through *G* will have to be cut larger than that through the jaw, to receive the iron socket (Fig. 37). This enlarging can be done afterwards with a chisel.

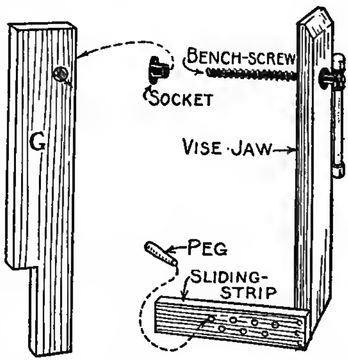


FIG. 37. FIG. 38.
FIGS. 37 and 38.—Details of Bench-Vise.

Screw the iron socket to the inside face of board *G*, and screw the iron plate on the handle end of the bench-screw to the face of the jaw. For the sliding-strip (Fig. 38), cut a piece of board 3 or 4 inches wide and 18 inches long, bore a number of small holes through it ½ inch apart, and nail it to the left edge of the lower end of the jaw, at the proper height so it will slide through the opening in board *G*. Cut a wooden peg to fit the holes.

The holes shown in the apron board *E* (Fig. 34) are bored for an adjustable peg to support the end of long pieces of work.

Figures 34 and 35 show how to

Fasten the Work-Bench to the Floor with Hinges. This is an excellent way of making the bench solid and preventing its sliding over the floor while you are working at it. One pair of hinges on the back, and another pair on the front, will do. The front pair are shown attached to the bottom of the bench and to the floor, and the rear pair to the back of the bench and to the floor. Either method of attaching them may be used, the only thing to consider being which surface will provide the best hold for the hinge screws.

The right-hand packing-case will make

An Excellent Tool-Cabinet, and all that is necessary to convert it into one is to hinge a door upon the front, and provide racks and hooks for tools. Box boards may be battened together for the door. The door may be hinged directly to the end of the packing-case, but it is better to nail a narrow hinge-strip to the face edge of the packing-case, and then hinge the door to this strip (see *Hinges and Hinging*, page 58). Screw a *hinge-hasp* to the door, and a *hasp screw-eye* to the packing-case; then you may keep your cabinet padlocked if you wish.

Figure 34 shows

A Good Rack for Bits and Chisels, made by notching the edge of a strip of wood and screwing it to the door.

A Tool-Chest is easily made out of a grocery box or small packing-case, about 28 inches long, 14 inches wide, and 10

inches deep. Select a box that is in sound condition, and renail all the boards to reenforce them.

The chest shown in Figs. 39 and 40 has a *drop-leaf* in front. This is an improvement over the common form with a solid front, because you can reach down under the tray and get a tool in the bottom of the chest, without having to remove the tray. One of the side boards of the box should be removed for the drop-leaf (Fig. 41), and it should be hinged to the remaining portion of the side as shown (Fig. 39).

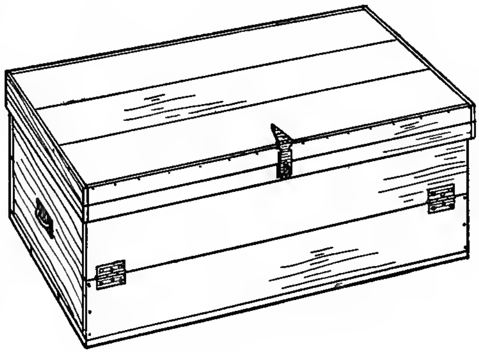


FIG. 39. — The Complete Tool-Chest.

Batten together the cover boards upon the under face with two battens, as shown in Fig. 40. Then cut a number of strips 2 inches wide and ⅜ inch thick, and make a rim for the cover, nailing the strips to the edges as shown in the illustration. Set the cover upon the top of the box, locate where the lower edges of the rim come, and at this point nail a band of 2-inch strips around the box. This will form a ledge for the cover to set upon. Hinge the cover in place as shown in Fig. 42. Fasten a *hinge-hasp* to the cover, and a *staple* to the narrow band strip nailed to the drop-leaf; then, by throwing the hasp over the staple, and slipping a

padlock through the staple, not only will the cover be locked, but the drop-leaf will be also. Procure a pair of *chest-handles* (Fig. 100, page 57), *drawer-pulls* (Fig. 102), or *sash-lifts* (Fig. 103) for handles, and screw one to each end of the box.

The tool-tray should be made a trifle shorter than the

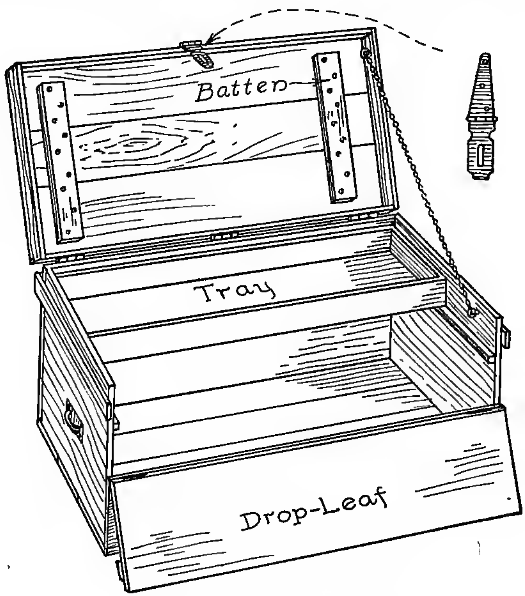


Fig. 40. — The Tool-Chest Opened.

inside length of the box, about one-half of the width of the box, and 2 or 3 inches deep, and a small strip should be tacked to each end of the box, inside, for a cleat to support the tray.

Hooks and pockets may be fastened to the inside of the

cover, to hold small tools, and the bottom of the chest may be partitioned off with strips for the planes, saws, etc.

Stain the chest any color you wish to have it, making a stain out of oil paint thinned with turpentine, if you haven't any regular wood-stain on hand. When the stain has soaked in, give the chest a coat of shellac.

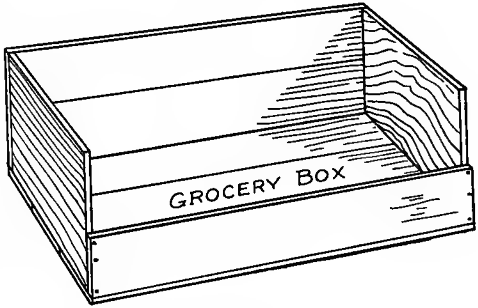


FIG. 41. — Box with the Side Board Removed for Drop-Leaf.

Selection of Tools. When a handy boy works upon his first piece of carpentry, he does not require a complete tool outfit; but such tools as he has should be good ones. It is far better to own a few tools of the best quality than a quantity of poor quality. The first cost is greater of course, but with proper care they will last a life-time. In my tool-cabinet are the first saw and hammer I ever had, the same with which I built a play-house in my back yard when seven years old, and there are other tools also there which were given to me or purchased by me when a boy, which are still in good condition and in use.

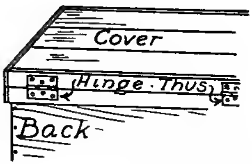


FIG. 42. — How to Hinge the Cover.

The Most Important Tools, and those with which a boy can

get along very well at the start, are the following: a hammer, hatchet, cross-cut saw, smoothing-plane, chisel, bit and bit-brace, screw-driver, and square. Of course it is supposed that you will have a good jack-knife in addition to these tools, because a knife is indispensable in any kind of carpentry.

As you progress in your work, additional tools will be required, and, to aid in the selection of these, I have made out the following

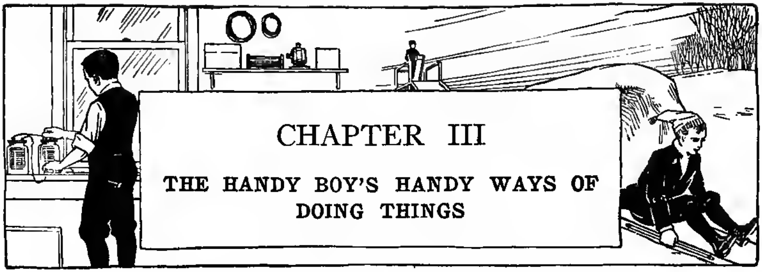
LIST OF TOOLS FOR A MEDIUM-SIZED TOOL OUTFIT

1 Hammer
1 Tack-hammer
1 Nail-set
1 Wooden Mallet
1 20-inch Cross-cut Saw
1 22-inch Rip-saw
1 Compass-saw
1 Key-hole saw
1 Back-saw
1 Coping-saw or Bracket-saw
1 18-inch Fore-plane
1 14-inch Jack-plane
1 9-inch Smoothing-plane
1 Ratchet-brace with 8-inch sweep
Auger-bits, 1/4 inch, 3/8 inch, 1/2 inch, 5/8 inch, 3/4 inch, and 1 inch
Wood-drill Bits; several small sizes
1 Expansive-bit
2 Brad-awls of different sizes
2 Gimlets of different sizes
1 Countersink-bit
1 Automatic-drill
1 Spiral-ratchet Screw-driver
1 Hand Screw-driver
1 Screw-driver Bit
5 Firmer Chisels, 1/4 inch, 3/8 inch, 1/2 inch, 3/4 inch, and 1 inch
2 Gouges, 3/8 inch, and 3/4 inch
1 Cold-chisel
1 Jack-knife
1 Draw-knife
1 Spoke-shave
1 Half-round wood-file
1 Wood-rasp
1 Flat Metal-file
1 Slim Taper-file
1 Rat-tail File
1 2-ft. Folding-rule
1 Try-square
1 Carpenter's Steel Square
1 Bevel
1 Marking-gauge
1 Pair of Wing Dividers
1 Level
1 Pair Cutting Pliers
1 Wrench
1 Oilstone
1 Grindstone
1 Oiler

If you know of a friendly carpenter in your neighborhood, he will likely be glad to give you advice about the selection

of your tools, and perhaps pick them out for you. You can depend upon his opinion as being more reliable than that of the average hardware dealer.

Chapter 2 of the author's "The Boy Craftsman" contains suggestions on "The Proper Handling of Tools," and there are chapters upon "Elementary Manual Training," "Wood Finishing," and "Working-drawings" in the companion volume, "Handicraft for Handy Boys," all of which is invaluable material for the untrained handy boy.



CHAPTER III

THE HANDY BOY'S HANDY WAYS OF DOING THINGS

When a handy boy tackles a job, it is with a feeling of confidence in his ability to carry it through to a successful completion. He knows just how to go about it, works systematically, and handles his tools like a trained mechanic. It is a pleasure to watch him work.

Handiness comes more natural to some boys than to others, but any boy can acquire it who will employ a portion of his spare time in experimenting and working out handy boy ideas. Clumsiness is simply a lack of the knack of doing things gracefully, and can be overcome by a boy who properly applies himself, and thinks out the cause and effect of each tool operation while working.

This chapter has been prepared for the purpose of showing methods of doing a large number of things handily. The material has been selected because of its general usefulness to boys, yet the greater part of it is applicable to ideas presented in following chapters of "The Handy Boy."

Nails and How to Drive Them. One of the most important things for a boy to know, in carpentry, is the proper methods of nailing materials together. Perhaps you have never given the matter much thought, beyond taking care to strike a nail square upon its head to make it drive straight.

Straight nailing must be mastered, of course, but it is no more necessary to drive a nail straight, than to place it in the right position, where it will do the most good, and where it cannot split the wood. A bent nail is easily withdrawn, but a board split as the result of improper nailing can seldom be made to look "as good as new." The magic power of putty is limited, and too much dependence should not be placed on it to conceal poor workmanship. Almost every time you split a piece of wood while nailing, it is the result of one of three conditions — too large a nail, the wrong position for the nail, or carelessness in driving the nail.

Kinds of Nails. Nails are made of *wrought-iron* (bright and galvanized), *wire*, *copper*, and *brass*. You will have little need of *wrought-iron* and *brass nails*, but you will use the *common wire nail* for rough work, and the *brad* and *finishing-nail* (small-head wire nail) for the better kind of work where you wish to drive the heads below the surface of the wood and, in doing so, make as small holes as possible. *Copper* or *galvanized nails* should be used for outside work where wire nails would rust through and break off. Figures 55 to 61 show the common forms of nails.

Sizes of Nails to Use. The size of nail to use always depends upon the working material. Thin wood is more easily split than thick wood, soft wood more easily than hard wood, and very dry wood more easily than wood which is not thoroughly seasoned; because there is not so strong a bond between the wood fiber of thin, soft, and very dry wood, as between that of thick, hard, and " green " wood.

Nails are known as 2-*penny nails*, 4-*penny nails*, 6-*penny nails*, etc., according to length, the term *penny* having evolved from the old English method of reckoning nails by the weight in pounds of a thousand nails — thus, 2-*penny nails* weighed 2 pounds per thousand nails, 4-*penny* 4 pounds per thousand, and so on. Through abbreviation, the word *pound* became *pun*, and then in some mysterious manner *penny* was substituted. The term penny has not, and never has had, any bearing upon the number of nails sold for a penny, as is often supposed.

Following is a List of the Standard Sizes of Nails:

2-penny	Nails	(1 inch long)	10-penny	Nails	(3 inches long)
3- "	"	(1¼ inches long)	12- "	"	(3¼ " ")
4- "	"	(1½ " ")	16- "	"	(3½ " ")
5- "	"	(1¾ " ")	20- "	"	(4 " ")
6- "	"	(2 " ")	30- "	"	(4½ " ")
7- "	"	(2¼ " ")	40- "	"	(5 " ")
8- "	"	(2½ " ")	50- "	"	(5½ " ")
9- "	"	(2¾ " ")	60- "	"	(6 " ")

Nails 4 inches and longer (20 to 60-penny nails) are known as *spikes*.

When Driving Nails into Thin Wood, and close to the edges of boards, holes should first be started with an awl or drill to lessen the danger of splitting. The holes should be enough smaller than the nails so the nails will drive in securely, and it is a good plan, when the wood is very thin and delicate, to run the end of the awl or drill into a bar of soap, to make it drill easily, without wedging the grain apart so as to split it.

Holes Should be Started in Hard Wood also, when small wire nails are used, so the nails will not have to be driven with force enough to make them bend. These holes should be smaller than the nails.

Figure 54 shows a simple method of

Supporting Short Nails with Pincers while driving them, to prevent bending; this should also be done when the nails you use are too short to hold conveniently between your fingers.

When a Nail Shows a Tendency to Bend, after having been driven part way in, it is generally quickest to withdraw it at once, and hammer it out straight or replace it with another nail. By striking it just right, it is possible to "drive home" a nail after it begins to bend, but before doing so you must figure on what is going to become of the point. The point of a bent nail will just as likely as not break out of the side of your work, splitting the wood, and making its withdrawal necessary after all. When a nail does break out of the side of a board, it should be removed by driving back its point with a nail-set, or the square end of a wrought-iron nail, until the head can be gripped with a pair of pliers or the claw of a hammer.

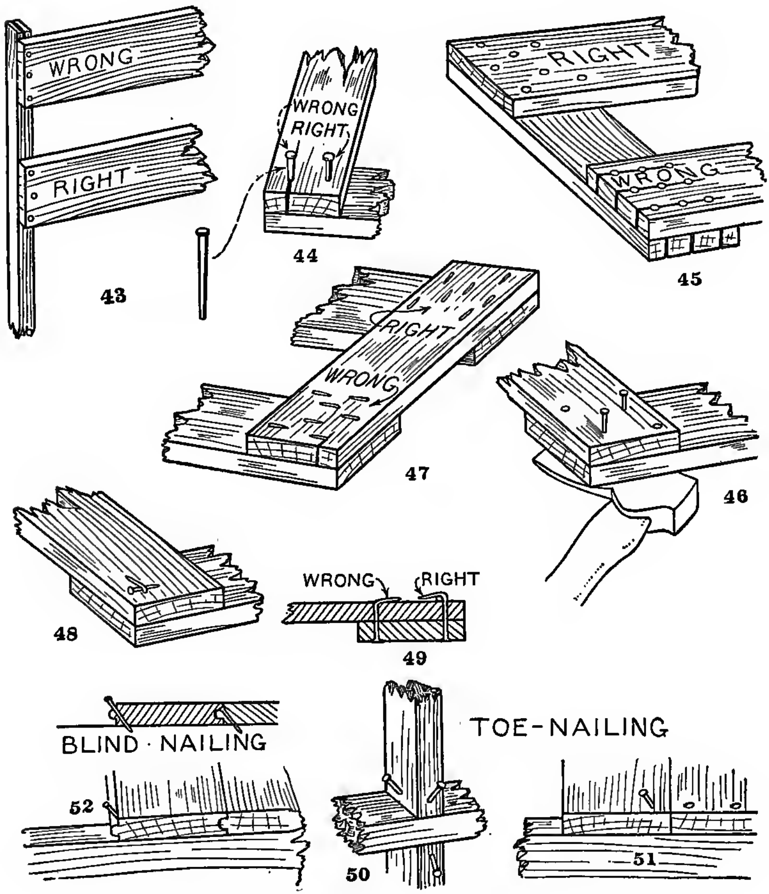
Figure 53 shows how to get an increase of leverage in

Withdrawing a Nail, by slipping a block of wood beneath the hammer head. For a very long nail, start with a thin block, and then substitute thicker blocks as the nail withdraws. Besides increasing the leverage, such blocks protect the surface of wood from injury by the hammer head,

and make it possible to withdraw nails without bending them.

Figures 43, 44, and 45 show examples of

Right and Wrong Nailing. To avoid splitting a board,



FIGS. 43–52. — Right and Wrong Methods of Nailing.

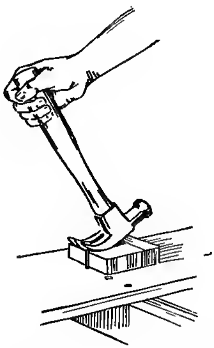
when driving a series of nails through it, do not place the nails in rows lengthwise of the grain. A nail acts as a wedge, and its tendency is to wedge apart the grain. Under favorable conditions, one nail will simply compress the grain sufficiently to make room for its passage; but if you drive two or more nails in a row between the same wood fibers, the probability is that the wood will split in the direction you are nailing, from the first nail driven to possibly the end of the board.

You must consider the lower board as well as the upper one. Taking the case shown in Fig. 43, for example, the nails would not split the upper piece if placed in a row as shown, because they extend across the grain; but there would be a strong tendency for the lower piece to split, because the nails drive down between the same wood fibers. By *staggering* the nails as indicated in the right method, the trouble is entirely obviated.

Figure 45 shows one of the worst possible forms of nailing — a tit-tat-toe arrangement, with the nails wedging apart the grain of both upper and lower pieces of wood. Any boy who has learned exactness, and likes to have everything square and in line, is inclined to drive nails in this fashion, thinking that it will look nice to have the heads line up. Notice how the nails are *staggered* in the right method, so that no two in rotation follow the same grain.

Another tendency of the beginner is to use too many nails in one place. It is so much fun to drive them in, that he often fills every available spot, without considering how

many are necessary. This is a fault to overcome, if you have it, because too many nails in one spot are as bad as too few, separating so many fibers of the wood, that the wood becomes weakened, often to the extent that it will split when put under any strain. There is no fixed rule for determining how many nails to use in a given area of wood surface, because there are so many conditions to consider



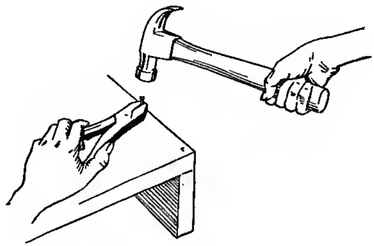


Fig. 53. — How to Withdraw Nails.
Fig. 54. — How to Support Short Slender Nails while Driving Them.

— including the kind and size of material, and the strain, if any, to which it will be subjected.

Hold your Hammer close to the handle end. That gives the maximum amount of leverage, and enables you to strike the heaviest blows. After starting the nail with short, light strokes, use long, heavy strokes, bringing the head down square upon the nail-head. When you have once learned to handle the hammer properly, always concentrate your entire thought upon the nail-head, and never mind the

hammer. The hammer will strike squarely just as long as you keep your eye and thought upon the nail-head. The instant that you shift your eye to something else, however, watch out for a mashed finger, a bent nail, or a damaging blow upon the surface of your work.

Clinching Nails. Nails should never be so long that their points will protrude from the under side of a piece of work, unless you wish to clinch them for the purpose of riveting the pieces together, so to speak. Clinching should not be done on parts of nice work which will be exposed to view; instead, if there is any possibility of nails not holding, use screws. The ends of nails can be clinched by laying the work upon the side of a hatchet, and then driving the nail so the point will strike its hard surface (Fig. 46). The points will then bend over and drive tight up against the wood.

Figure 47 shows the right and wrong way of clinching. When you clinch nails in the direction of the grain, the ends will drive into the wood; when you clinch them across the grain, the ends will not lay flat. If you clinch a nail by hammering over its end, bend it over a nail as shown in Fig. 48. In this way the point will sink into the wood. If you do not do this, the middle portion of the nail will drive in, and the point will stick up (Fig. 49).

Figures 50 and 51 show two examples of

Toe-Nailing. This form of nailing consists in driving nails diagonally into pieces of work. In Fig. 50 is shown an instance where toe-nailing is the only possible way to nail

the ends of two uprights to a horizontal piece, while Fig. 51 shows how toe-nailing is done to drive one board close up against another. It is sometimes convenient to toe-nail when the nails at hand are too long for a piece of work.

Blind-Nailing is a form of toe-nailing generally used upon *tongued-and-grooved boards*, in which the nail-heads are concealed upon the edges of the boards, as shown in Fig. 52.

Screws and How to Drive Them. Figures 62 to 66 show the common varieties of screws. Of these you will have little use for others than the *flat-head screw*, and *round-head finishing-screw*, in carpentry.

When fastening together hard wood, or very thin wood, drill holes for the screws before driving them. It makes the driving easier, and eliminates the danger of splitting the wood. The hole in the upper board should be a trifle larger than the diameter of the screw, so the screw will not bind in it; and the hole in the lower board should be a trifle smaller than the screw, so the screw will thread its way into the wood and take a good hold on it.

When you Screw Cleats or Battens across wide boards, it is best to bore the holes in the upper piece considerably larger than the screw, because the shrinkage in the width of wide boards amounts to a good deal, and if the screws cannot shift enough in the holes in the cleats or battens to take care of it, the wood will split. If necessary, place washers beneath the screw-heads to support them.

To Drive Screws into Hard Wood. Screws will drive into hard wood easier if they are *soaped*, that is, pushed into a

piece of soap so as to coat the threads with grease. By soaping slender screws, and thus making them drive easier, there is less danger of twisting their threads and breaking them off.

Countersinking Screw-Heads. Screws can be driven far enough below the surface of soft wood, or *countersunk*, so the heads can be concealed with putty; but for hard wood it will be necessary to bevel the tops of the screw-holes with a *countersink-bit*, before driving them, so the heads will drive below the surface.

Do Not Drive Screws too Close Together, along the same grain, unless holes have been drilled first, or the wood will split. The rules given for nailing also apply to driving screws (see Figs. 43 and 45).

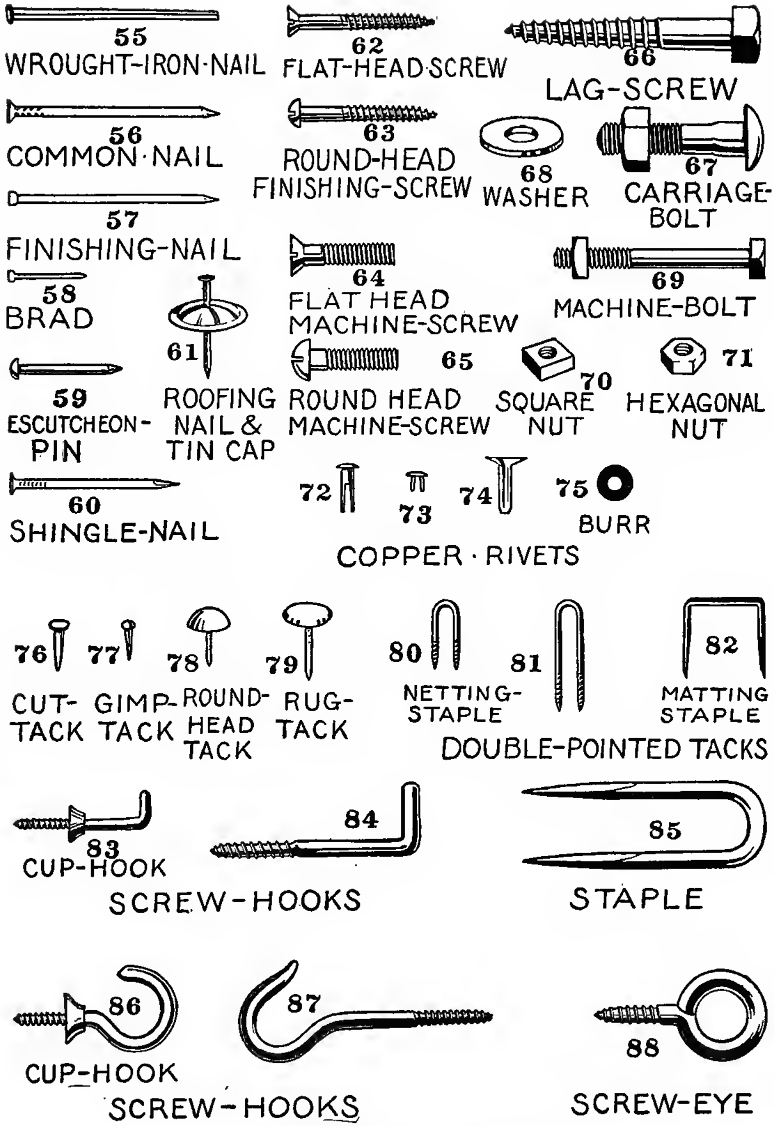
To Withdraw a Rusted Screw. When a screw has become rusted, striking its head a few blows with a hammer helps to loosen it. A red-hot iron held to the head of the screw for a few seconds also helps.

To Lock a Screw in a piece of wood, so it will not work loose, take a small staple such as is shown in Fig. 82, and drive it down over the screw, so that the top fits in the screw slot.

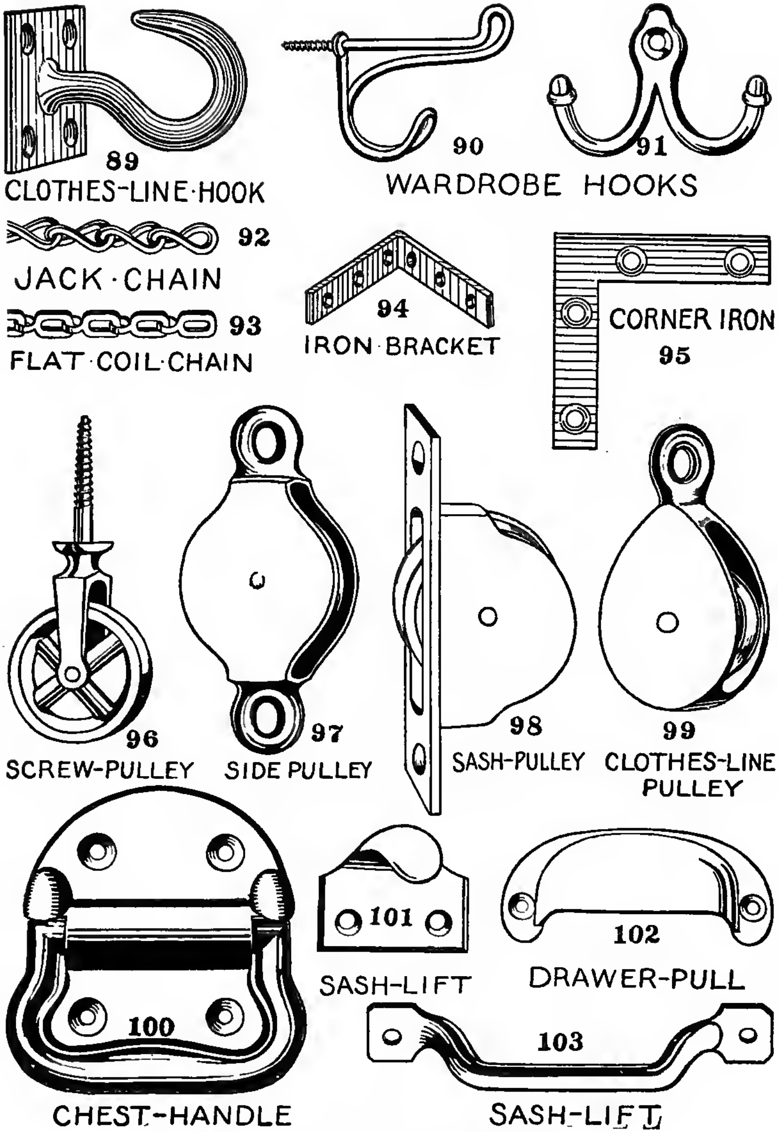
On pages 56, 57 and 59, under the heading of

Handy Boy Hardware, are shown illustrations of all the more common pieces of hardware which a boy will have occasion to use, together with the names by which they are generally known.

Boys' work is often of so unusual a character that hard-



FIGS. 55–88. — Handy Boy Hardware.

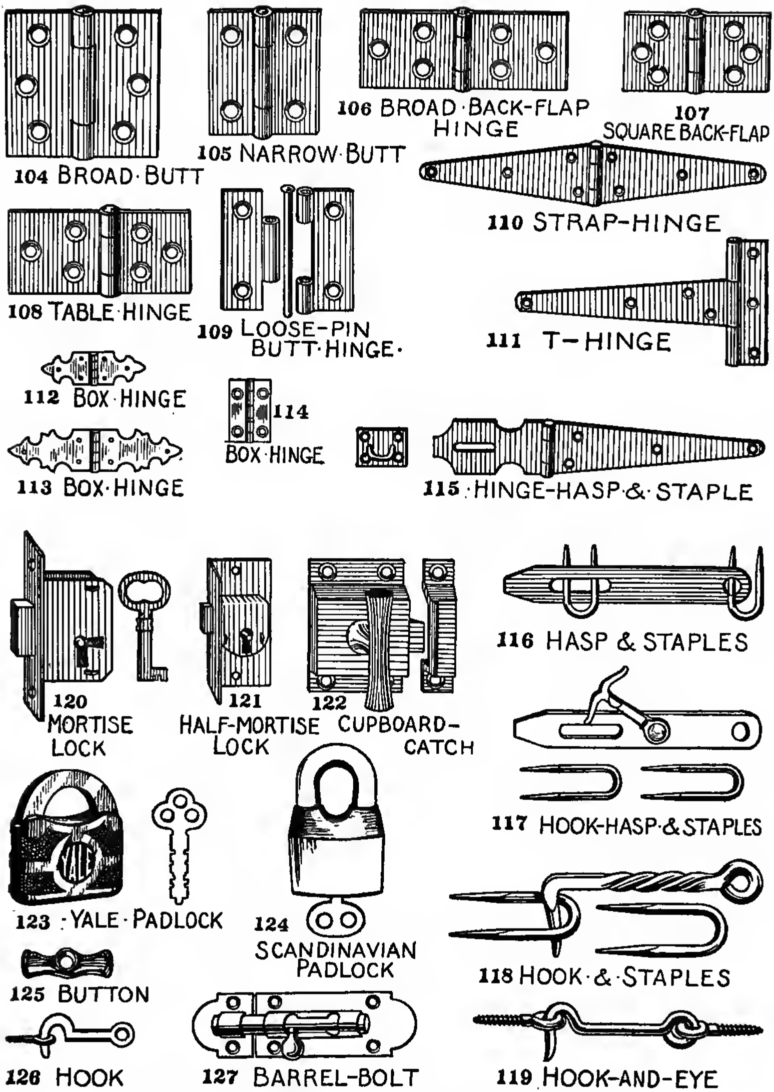


FIGS. 89–103. — Handy Boy Hardware (Continued).

ware must be adapted to purposes other than what it is intended for, and these illustrations will be helpful in suggesting just what is needed. The author has a number of boxes, which he calls his

Junk Boxes, filled with miscellaneous hardware of every description, some of which was originally saved by his grandfather. This collection of odds and ends is always resorted to when something out of the ordinary is needed for a certain part of a piece of work, and it seldom fails to supply what is wanted. Such a collection is invaluable to the experimenter, and every handy boy should start one if he has not one already. Every repair made about the house will contribute an odd scrap of hardware to your collection, and it will not take long to accumulate a good variety of junk. A number of small boxes are better than one or two large boxes, because pieces of a similar nature can then be kept together, which saves time when it comes to looking for a certain piece.

Hinges and Hinging. Figures 104 to 114 show all the forms of hinges which a boy will ordinarily use, and Figs. 128 to 140 show the different methods of fastening them upon doors and box covers. In Fig. 128 the hinge is screwed upon the face of a door, which is the simplest and quickest method of attaching it; and Fig. 133 shows how a box-cover is hinged in the same manner. In each instance, there must be a hinge-strip alongside of the door, or the cover, large enough to screw one *flap* of the hinge to, as shown in the illustrations. Figures 129 and 130 show how



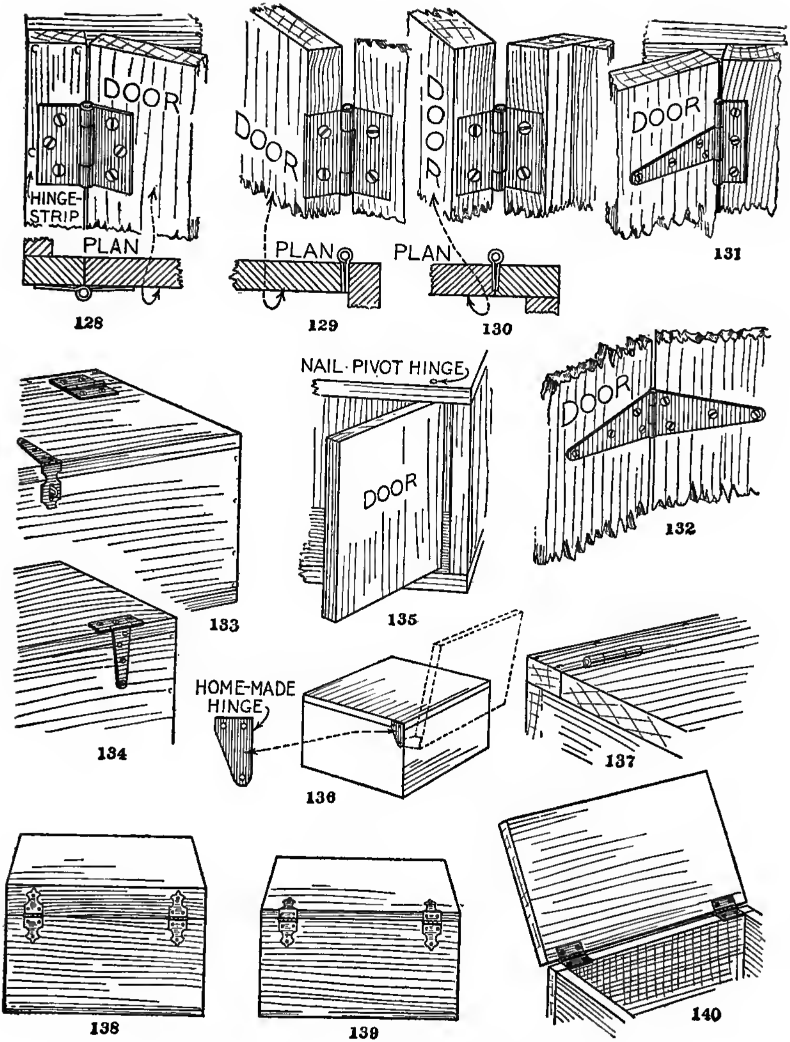
FIGS. 104–127. — Handy Boy Hardware (Continued).

the same form of hinge is sunk into the edge of the door, and into the door-jamb. These methods are used in hinging cabinet doors, when it is desirable to conceal the hinges as much as possible. By using a hinge with a flap narrower than the thickness of the door, like that shown in Fig. 130, the inside edge of the flap is not exposed as it is in Fig. 129. In Fig. 129 the second flap of the hinge is screwed to the side of the cabinet, while in Fig. 130 it is screwed to a hinge-strip, or *stile*.

Figure 137 shows an application of this method of hinging a box-cover to a hinge-strip; and Fig. 140 shows a method of screwing the hinges to the inside face of the cover, and to the top edge of the box. This scheme is often used upon cabinet doors, when the doors must be made the full width of the cabinet opening, and a hinge-strip or stile cannot be used. When the door is made of thin material, it is necessary to place the hinges either as shown in Fig. 128, or as in Fig. 140, in order to have width enough to drive in all of the screws, and so that the screws may not split the wood.

The *narrow butt-hinge* (Fig. 105), the *loose-pin butt-hinge* (Fig. 109), and the *box hinge* (Fig. 114) are best for fastening to *edges* of doors and box covers, and the *broad butt-hinge* (Fig. 104), and *broad* and *square back-flap hinges* (Figs. 106 and 107) for fastening upon *faces* of doors and box covers.

Attaching Hinges. When hinges are screwed to the edge of a door, they must be sunk into the wood, as shown in Figs. 129 and 130, so there will be a tight joint between the door and the jamb when the door is shut. The *recesses* for



FIGS. 128–140. — How to Hinge Doors and Box Covr

the hinge flaps must be laid out accurately upon both the door and the jamb, in order to get them at the same heights, and they must be cut to the proper depth, so the door will close properly.

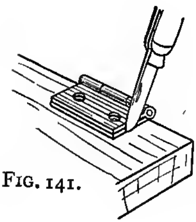


FIG. 141.

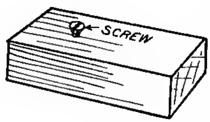


FIG. 142.

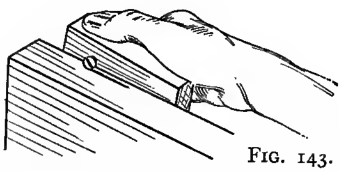


FIG. 143.

FIG. 141. — How to Lay out Position of Hinge.
FIG. 142. — A Depth-Gauge.
FIG. 143. — How to Use the Depth-Gauge.

Figure 141 shows how to place the hinge upon a door and mark its location with a knife, and Fig. 143 shows how to gauge the depth of the recess with

A Home-Made Depth-Gauge. The gauge is nothing more than a block of wood with a flat-head screw driven into it to the proper depth so the distance between the block and the top of the screw-head is equal to the desired depth (Fig. 142). The recess must be a trifle deeper than the thickness of the flap, because there is a space between the flaps when the hinge is folded, and if this is not taken care of by sinking the flaps that much more, there will be a wide joint between the door and the jamb. On the other hand, if the hinges are sunk too deep, or one is sunk deeper than the other, the door will not close properly, as the edge will bind against the

door-jamb. With your depth-gauge properly set, and with careful cutting, there will be no trouble in getting the depths uniform. If you should happen to cut a recess too deep, a piece of cardboard can be used to block it out, while, if not deep enough, it is an easy matter to trim it a little deeper. Fasten the hinges to the door, first, then set the door in position, and mark the places for the hinges upon the jamb; proceed in the same way in hinging a cover to a box.

There will be no difficulty in screwing hinges to the face of work, if you watch out for two things — to get the *knuckle* (the encased center pin of the hinge) over the exact center of the joint, and to get it parallel with the joint. If the hinges are put on crooked, they will bind.

It is best to

Drill the Hinge Screw-Holes, after marking their exact centers. This prevents the screws from working the hinges out of position, as they often do when the holes are not started first; besides, it lessens the chances of the screws splitting the wood. Several screws driven in a row along the same grain are likely to split the wood; that is why the screw-holes in hinges are *staggered* when there are three or more in each flap.

The *strap-hinge* (Fig. 110), and the *T-hinge* (Fig. 111) are used upon heavy work, such as shed doors, etc. The long straps extend over a greater area than the flaps of the butt-hinge, and the screw-holes are spread out so the screws do not follow along the same grain of the wood; therefore, the

screws take a firmer hold, and there is less danger of the wood around them splitting. The strap-hinge will carry more weight than a T-hinge of equal size, of course, on account of having two long straps.

Figure 134 shows a good method of attaching a box cover with T-hinges. Strap-hinges might be put on in the same manner.

The Nail Pivot Hinge shown in Fig. 135 is a novel method of hinging a small door. You will see by the illustration that it consists of a nail driven through the shelf above and below the door, into the ends of the door. Set the door in the opening, and wedge in a folded piece of cardboard both above and below it, to hold it in position; then locate the positions for the nails so they will come exactly over one another, and drive them into the door ends.

A Home-Made Box-Hinge that is easy to make is shown in Fig. 136. It is cut out of a piece of tin or brass of the shape shown, and has three holes punched through it. The upper end is fastened to the edge of the cover with small tacks driven through the upper pair of holes, and the lower end is pivoted to the end of the box with a tack driven through the single hole. The dotted lines indicate the position of the cover and hinge when the cover is open.

Ornamental Box-Hinges (Figs. 112 and 113) are sold in nickel and brass finish, and are used upon fancy boxes. Figure 138 shows how they are tacked to the back of a box having a cover with a rim, and Fig. 139 shows how one flap may be bent to fit over the edge of a cover with-

out a rim, and be nailed to both the edge and top of the cover.

Gauging with a Rule and Pencil. When a carpenter wishes to rip a strip, say 2 inches in width, from a board, he holds his folding-rule upon the board with his left hand, as in Fig. 144, with his first finger even with the 2-inch measurement; then, holding his pencil with the point

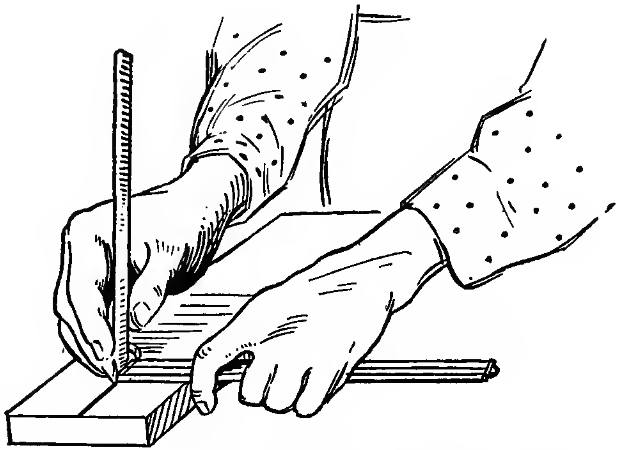


FIG. 144. — How to Gauge with a Rule and Pencil.

against the end of the rule, he slides the rule along the board, and scribes a line that is parallel to and exactly 2 inches away from the edge. This is easy to do, as soon as you get the knack of holding the first finger against the edge of the board, and the pencil point against the end of the rule; and this is easily acquired with practice.

Gauging with a Carpenter's Square and Pencil. Figure 145

shows how gauging can be done with a *steel square.* A *try-square* can also be used for the purpose.

Such operations as the above save considerable time over that of measuring off a number of times the width of the strip to be cut, and then connecting the points with a straight line; and the expert mechanic is always quick to adopt every time-saving operation possible, because time is valuable to him.

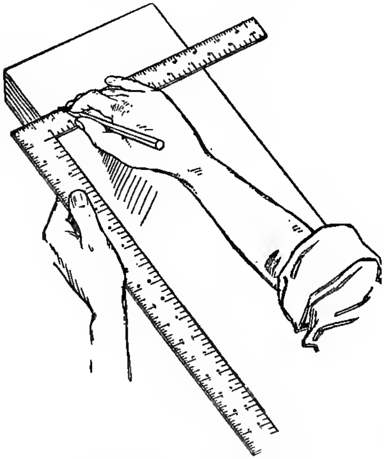


FIG. 145. — How to Gauge with a Carpenter's Square and Pencil.

Another time-saving operation is that of

Dividing a Board into a Number of Equal Parts, as shown in Fig. 146. When a board is of an odd width, it requires a minute or two to figure out the divisor that will divide it into the number of equal parts desired, and then several more minutes to lay off the fractional measurements accurately. Instead of doing this, the mechanic takes his rule, or his large square, and places it across the board as in

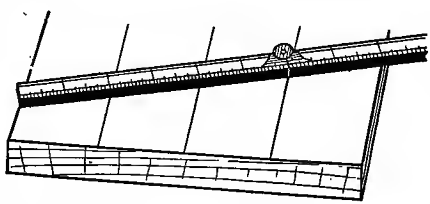


FIG. 146. — How to Divide a Board into Equal Parts.

the illustration, with one end at one edge, and the inch division-mark equal to some multiple of the number of divisions desired, at the other edge. Then the division points are quickly laid off, and lines ruled through these points. The board in the illustration is divided into four equal parts, and to get the points the end of the rule was placed at one edge of the board, and the 8-inch mark (a multiple of 4) at the opposite edge. Then the divisions were laid off along the rule, 2 inches apart.

A Jack-Knife Plumb-Bob. When putting up a framework of any kind, it is important to get the uprights *plumb*. With nothing else at hand, a very good plumb-bob can be made by tying your jack-knife to the end of a cord (Fig. 147). Then, holding the upper end of this *plumb-line* about 1 inch away from the top of the upright, allow the knife to swing until it comes to a rest; have the distance between the cord and the upright, just above the knife, measured, and if the measurement does not correspond to that at the top (1 inch), shift the upright until the two distances are equal. The upper end of the plumb-line should be supported on the end of a rule or stick held upon the top of the upright.

Figure 148 shows how to fasten the cord to the knife. Pass the cord around one end, between the blade partitions, and open one blade and close it on the cord; then bring the cord to the other end and tie a *square knot*, as shown. Tie the knot close to the knife-end, and be careful to center it exactly on the knife-end.

A Spinning-Top Plumb-Bob. A regular plumb-bob is of the

shape of a boy's top, tapering down to a point at the bottom. When suspended, the point of the bob is in an exact line with the upper end of the line, and so, by its use, a point can very easily be located on the ground that will be directly under another point above. A well-balanced top will do excellently for such a bob (Fig. 149). The plumb-

Fig. 147.

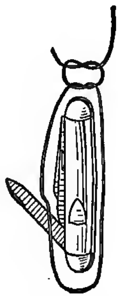
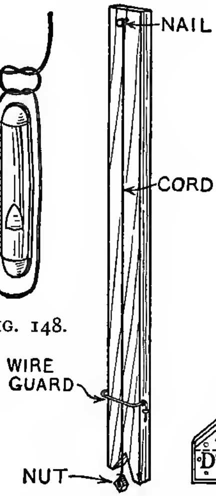


Fig. 148.



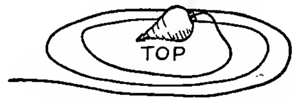


Fig. 149.

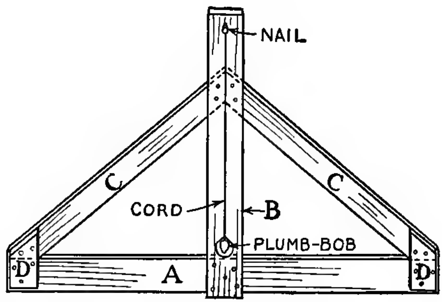


Fig. 150. — A Plumb-Board.

Fig. 151. — A Level.

Fig. 149. — A Spinning-Top Plumb-Bob.

Figs. 147 and 148. — A Jack-Knife Plumb-Bob.

line may be tied to a double-pointed tack driven into the top, or may be wedged into the peg hole.

A Plumb-Board such as is shown in Fig. 150 does the same work as the jack-knife plumb-bob, but is more convenient to handle. A bolt-nut is used for the plumb-bob, and the upper end of the plumb-line is attached to a nail driven into

a board close to one end, in the center of its width. The edges of the plumb-board should be straight and parallel. In the exact center of the lower end of the board, cut a notch, and fasten a wire guard over the plumb-line several inches above this notch, as shown. When your plumb-board is placed against an upright, you can determine whether or not the upright is plumb by the position of the plumb-line when the bob comes to a rest. It should line up with the exact center of the notch.

A level is necessary for setting horizontal pieces of a framework, and if you haven't one,

A Home-Made Level such as the one shown in Fig. 151 will serve your purpose excellently. This is nothing more than a plumb-board fastened to a triangular framework. The board *A* must have a straight bottom edge, and the sides of the plumb-board *B* must be placed exactly at right angles to the bottom edge. The diagonals *C* are braces to keep board *B* vertical. Nail the upper ends of pieces *C* to the back of *B*, and tie the lower ends to the top of board *A* with the blocks *D*. Instead of cutting a notch in the lower end of board *B*, cut a round hole through the center of the board, just above board *A*, and notch the upper part of this, as shown. A nut, top, or any small weight, may be used for the bob.

A Post-Hole Digger. All boys, at one time or another, are in need of a post-hole auger, with which to dig post-holes for framework supports, yet post-hole augers are not always available. With a spade, it is necessary to dig a very large

hole in order to get down to a desired depth, but, having two spades, you can make a small, deep hole very easily by following the scheme shown in Fig. 152.

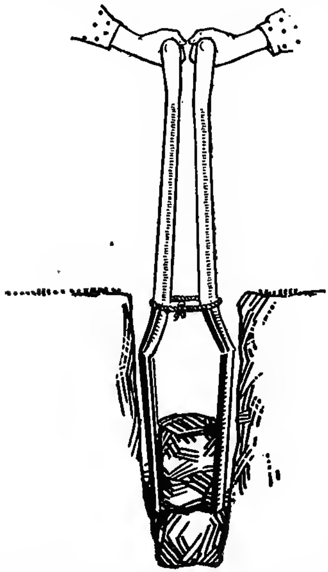


FIG. 152.—How to Dig Post-Holes.

Make a wire loop to slip down over the spade handles. Then push the spades into the ground with your foot, one at a time, placing one spade each side of the spot where you wish to dig the hole, with the blades facing in. When each spade has been pushed down as far as you can push it, drop the wire loop over the two handles; then push the handles away from one another, and lift. The wire loop will act as a *fulcrum*, and as you force the handle ends apart, the blades will press against the loosened earth and hold it between them while they are being raised out of the hole. The size of the wire loop can be regulated to suit the width of the hole.

Boring Large Holes. It is only occasionally that a boy needs to bore a hole larger than 1 inch in diameter, a 1-inch hole being plenty large enough to receive a broom-handle axle, drum, or any of the other parts for which broom-handles are used, so it is hardly necessary for him to own a

bit larger than this. Large holes can be cut as shown in Fig. 153. In this illustration, *A* shows the size of the hole to be cut, *B* shows the first step in cutting it — boring a ring of small holes inside of the circle, *C* shows the second step — splitting out the wood between the holes with a

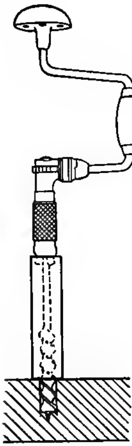


FIG. 155. — A Mailing-Tube Depth-Gauge for Boring Holes.

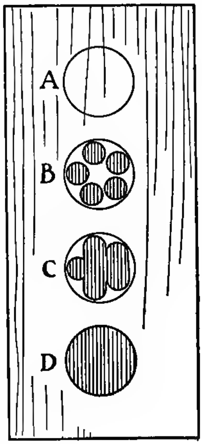


FIG. 153. — How to Cut Large Round Holes.

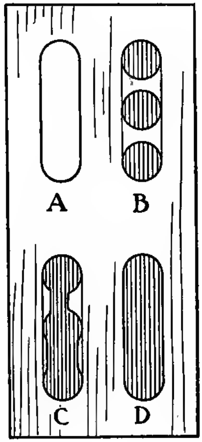


FIG. 154. — How to Cut Slots.

chisel, and *D* shows the finished hole, after the third operation — trimming up to the circle with a chisel.

The Cutting of Slots is done similarly (Fig. 154). First, the slot is marked out (*A*); then a hole is bored at each end, and one or more between them (*B*); then the wood between the holes is split out (*C*); and then the sides of the slot are trimmed up to the finished line (*D*). If the ends of

the slot are to be square, they must be squared up with the chisel.

Cutting Large Wooden Disks. Every boy has occasion now and then to cut out wooden wheels for various purposes. The easiest method of doing the circular cutting is illustrated in Fig. 584, page 375, in connection with the details of a wheelbarrow's construction, and the work is described on page 375.

When boring holes part way through a board, it is sometimes necessary to bore the holes just so far, and no farther. You will need

A Depth-Gauge for Boring such holes, and a piece of a mailing-tube will serve the purpose (Fig. 155). The tube should be cut off to the proper length so its top will extend to the lower end of the bit-brace when the depth of the hole has been reached. Then it will only be necessary to keep an eye on the top of the tube, and stop boring when the brace has reached that point.

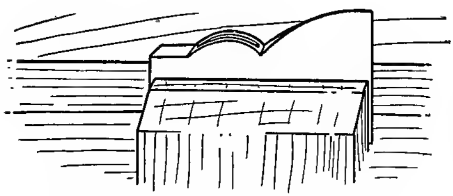


Fig. 156. — A Hatchet-Head Anvil.

A Hatchet-Head Anvil. When in need of an anvil, place a hatchet in your bench-vise as shown in Fig. 156; then the head will furnish a flat surface on which to straighten nails, etc., and the top edge of the blade will present a sharp edge over which to bend wire and metal.

Cutting Wire. Wire can be cut quickly and easily by placing it upon the edge of the hatchet-blade anvil, and giving it a few sharp blows with a hammer, then bending it back and forth a few times until it breaks.

Figure 157 shows

A Makeshift Wrench which can be used for such work as tightening nuts, etc. As you will see, it consists of a carriage-bolt, fitted with two nuts turned with flat sides facing each other.

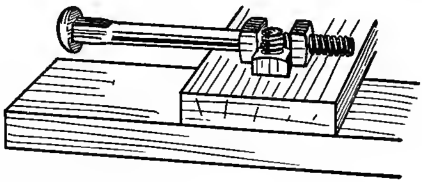


FIG. 157. — A Makeshift Wrench.

An ordinary monkey-wrench can be used as

A Small Pipe-Wrench, by slipping a file between the piece of pipe to be turned and one jaw of the wrench (Fig. 158). The rough surface of the file will enable you to get a good grip upon the pipe, which is not possible with the smooth jaws of the wrench alone.

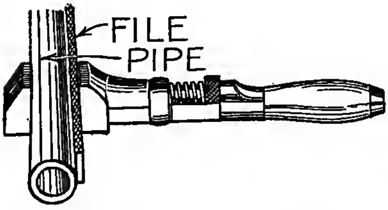


FIG. 158. — A Small Pipe-Wrench.

To Keep Tools from Rusting. Tools are subject to rust even though kept in a comparatively dry place. A good way to prevent them from rusting is to rub them occasionally with kerosene or a piece of suet. If the location in which you keep them is very damp, place an open can or pan containing unslaked lime in the bottom of the tool-chest or tool-cabinet. This will

absorb the moisture and keep the contents of the chest or cabinet dry. The lime must be replaced once in a while with a fresh supply.

To Remove Old Sash-Putty. In replacing a broken pane of glass of an old window-sash, it is often hard to remove the hardened putty. But if you will fill an oil-can with benzine or gasoline, squirt this along the putty, and then light it, the putty will soften and come off easily. The sash should be taken out of doors to do this.

To Remove Specks of Paint from Glass. When a window-pane has been speckled with paint, and the paint has hardened, the specks are easily removed by rubbing a penny over them, giving the penny a circular motion.

Soldering. Every handy boy should know how to solder, not only so he can solder together pieces of metal in his electrical and other experimental work, but so he will also be able to mend the wash-boiler, tea-kettle, and pans, for his mother, when they become leaky.

Some metals have never as yet been successfully soldered, others are very difficult to solder; but you will have no trouble soldering tin, copper and brass, and these are about all the metals you will have occasion to solder anyway.

It is easy to solder, once you get the knack of it; and of course the only way to get the knack of anything is to find out how it should be done, and then go ahead and do it.

Soldering outfits can be bought very cheaply. A small

outfit, consisting of a *soldering-copper*, a box of *rosin*, and a small coil of *wire-solder* (Fig. 159) can be bought for as little as 10 cents, and one of these will serve a boy's purpose just as well as a more expensive set. The solder may be of either the wire or bar form. The best kind to use is what is known as "half-and-half," which is composed of equal parts of tin and lead.

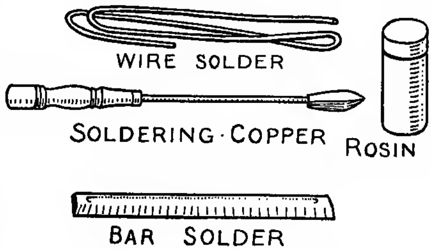


FIG. 159. — A Soldering Outfit.

The soldering-copper is used to spread the solder. The rosin acts as a *flux*, to make the solder flow readily and stick. A *soldering-fluid* is commonly used in place of rosin as a flux, and is better in instances where metals are greasy, because it cuts the grease and leaves the metal clean. This fluid is made of *muriatic acid* and zinc, and is easy to prepare. Get a few cents' worth of muriatic acid at the drug-store, pour a little into a small jar containing broken pieces of zinc (broken pieces of old battery zincs will do), and allow the acid to eat as much of the zinc as it will. Then pour the acid into another jar containing about twice the quantity of water that there is acid, and the solution will be ready for use.

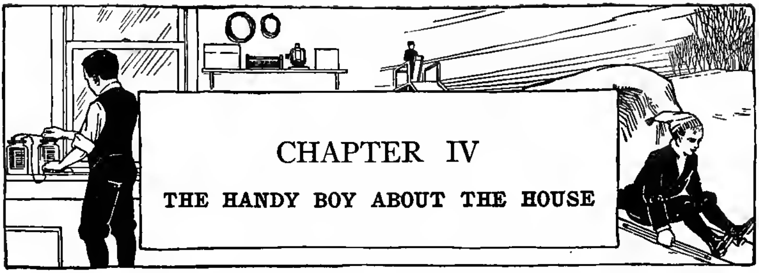
The soldering-copper must be *tinned;* otherwise, it will not work satisfactorily. One-half the secret of success in soldering is in having a well-tinned soldering-copper. Tin-

ning is an easy operation. First, file the sides and point of the copper until it is bright and clean; then place the copper in the flame of a gas-burner, or in a stove or a furnace. Heat it until it is somewhat hotter than your mother heats her flat-irons, but be careful not to get it red-hot. With the copper heated, remove it from the fire, and quickly brighten up its heated surface with a file; then place some rosin upon a piece of tin, rub the point and all sides of the copper over the rosin, thus melting the rosin into a liquid and coating every portion of the copper's surface with it; then rub the solder upon the surfaces. You may not be able to tin the entire copper before it has cooled, in which case you will have to reheat it. With the soldering-copper properly tinned, be careful not to heat it to a red heat, for if this is done the tinning will melt and drop off.

Suppose your first soldering job is repairing the bottom of a pan. First of all, it is important to brighten the tin around the hole by rubbing it with sandpaper or a file. When this has been done, put some rosin or soldering-fluid on the tin, and then, with the heated copper in your right hand and the solder in the left, touch the hole with the point of the copper, and at the same time bring the end of the solder down against the copper. As the solder melts, the point of the copper must be worked around slowly, to spread it over the hole and smooth it out.

If the hole to be soldered is large enough to require a patch, brighten its edges and also the edges of the tin patch. Then put soldering-fluid over the edges of the holes, and the

edges of the tin patch, place the piece of tin over the hole and melt the solder, and allow the solder to flow around the edge of the patch and under it. Hold down the patch until the solder has set.



CHAPTER IV

THE HANDY BOY ABOUT THE HOUSE

A HANDY BOY can make many little conveniences for the house or apartment that will help to lighten housekeeping, and add to the comforts of the family. And he can not only provide these conveniences for his own house or apartment, but take orders for duplicate articles for neighbors as well, which suggests a good opportunity to earn money. The easiest way in the world to get such orders is to make the articles and have them in use in your house; then your mother's friends will see them, and if you receive a few orders from them to start with, and fill these to complete satisfaction, your work will be recommended to others.

The suggestions upon the following pages are very practical for the house or apartment, and they are easy to carry out.

Figure 160 shows a novel scheme for providing

Additional Shelves for a Clothes Closet. This will appeal to every housewife. Ordinarily, the closets of apartments or small houses are provided with only one shelf, and the closets usually are not so large nor numerous but that there is a shortage of storage space. The single shelf is usually placed about 5 feet 6 inches above the floor, which leaves a space of 4 or 5 feet between it and the ceiling, and the

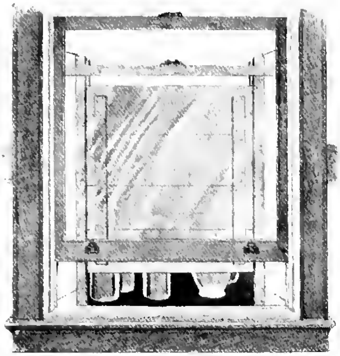


Fig. 162.—A Window Refrigerator.

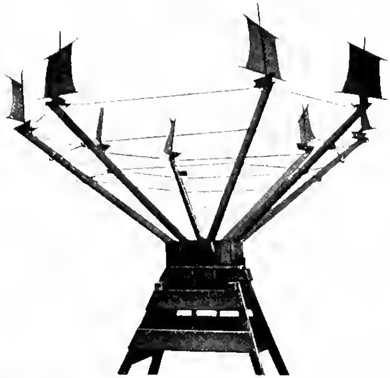


Fig. 163.—A Windmill Clothes-dryer.

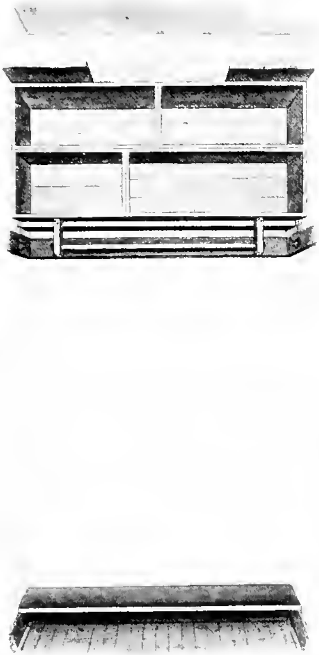


Fig. 160.— Additional Shelves for a Clothes Closet.

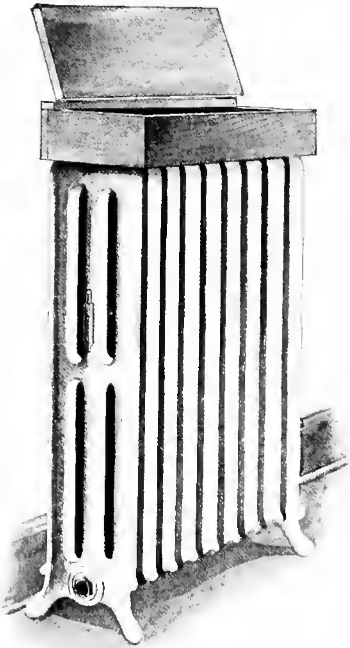


Fig. 161.—A Radiator Plate-warmer.

greater portion of this is useless if additional shelving is not provided.

Splendid shelving can be made by standing boxes one on top of another as in Fig. 160; and there can be no objection to putting these up in even a rented apartment, because they are not nailed to the wall, and can be pulled out at any time.

The appearance of the shelving will be better if you cut the boxes down in length so they will fit fairly snug between the plastered walls (Fig. 160). Perhaps you can pick out boxes of the right size at the grocery store, and save cutting them.

As a rule closet shelves are not more than 12 inches wide, but you may make the new shelving 16 or 18 inches wide, if you can get boxes this deep, so they will hold more. Nail the boxes to the shelf and to each other, to keep them in position. In the illustration you will notice that there is a shelf at each side of the closet, extending from the top row of boxes out toward you. These shelves extend over to the top of the door trim, to which their ends are nailed. By placing another board across the ends of these side shelves, you will have provided a shelf which extends around the four walls of the closet; and, unless the closet is very small, there will still be a large enough opening through which to put up the packages and articles to be stored.

So much for the upper shelving. Across the top of the wall base-board, a piece of board may be fastened from side to side of the closet, on which to keep shoes, slippers, and

rubbers; and a pole for coat-hangers may be made by supporting a broom-handle or curtain-pole between two short uprights, and screwing the upper ends of the uprights to the front edge of the original closet shelf. This curtain-pole will more than double the available hanging-space.

A radiator may be made to do service as

A Plate-Warmer, by providing it with a box such as is shown in Fig. 161. Make the box frame a couple of inches larger than the top of the radiator, using boards 6 inches wide; then fasten two crosspieces between the sides, even with the bottom edges, as in the detail of Fig. 164, spacing them so that when the frame is placed upon the radiator the cleats will come between the iron *sections*. Then fasten strips between these crosspieces and the ends of the box, and between the sides of the box, as shown, to form a ledge, and tack a double thickness of screen wire to the upper faces of these strips. Stretch the screen wire as tight as possible.

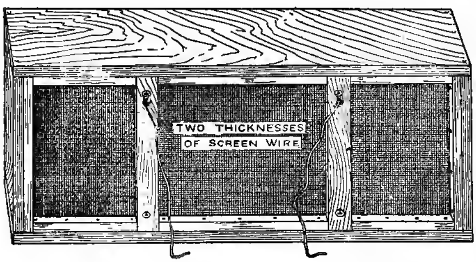


Fig. 164. — Detail of Bottom of the Plate-Warmer Shown in Fig. 161.

Nail a strip 2 inches wide across the back of the top of the box, for a hinge-strip, and hinge a board to this for a cover (Fig. 161).

Fasten the box in place upon the radiator with wire at-

tached to screw-eyes in the bottom of the center cross-pieces (Fig. 164), and passed under the *lugs* which separate the *sections* of the radiator.

Where the kitchen or pantry has a north or west exposure,

A Window Refrigerator will afford excellent satisfaction during cold weather. Figure 162 shows a practical scheme that is easily carried out. The box is not fitted close up to the window glass, as this would prevent the opening of the upper sash, and, to keep the dirt and snow from blowing into the box, a front is provided and so connected with the sash that the raising of the latter will raise the front of the refrigerator. This will be understood by examining the detail drawings (Figs. 166 and 167).

Two boxes of equal length and depth should be procured for the refrigerator. Those shown in the detail illustrations were 13 inches wide, 28 inches long, and 10 inches deep. The boxes are joined together with strips *A* and *B* (Fig. 165), which are fastened to the bottoms, and by the slide strips *C*. The latter strips should project on the front about ¼ inch more than the thickness of the cover boards, and should be cut long enough to extend about 8 inches above the top of the upper box. Next cut the strips *D* and fasten them to strips *C*, as shown, to form the back of the slides; and then cut the strips *E* and nail them to the edge of the strips *C* to form the front of the slides. The cover boards are fastened together with battens.

The arrangement for lifting the front consists of a cross-

bar about 2 inches thick fastened to the battens, and two nails driven into the window-sash. This is clearly shown in Figs. 166 and 167. The front of the refrigerator will drop when the sash is lowered, if it has been fitted loosely enough so that it will not bind when the wood becomes wet and swells; but, if there is any difficulty as a result of the end edges sticking, the bar can be wired to the nails which were driven into the window-sash for the purpose of lifting the front of the refrigerator, so that these will pull it down.

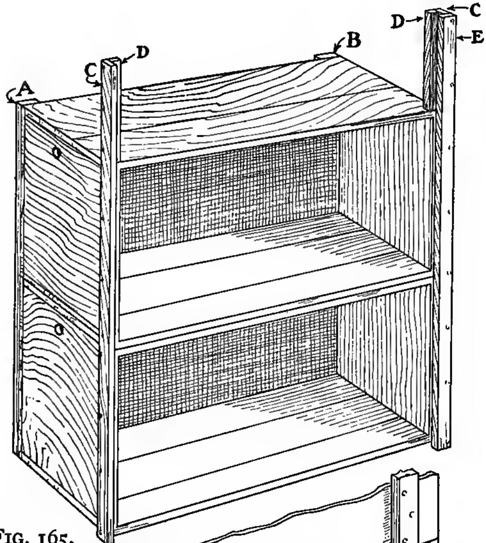


FIG. 165.

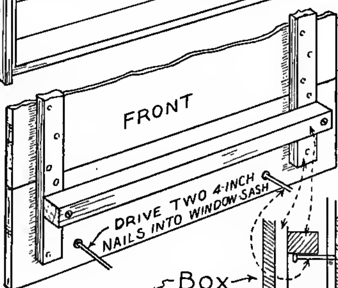


FIG. 166.

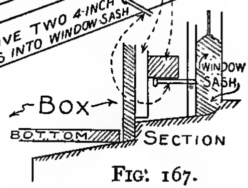


FIG. 167.

FIG. 165. — Detail of the Window Refrigerator. Shown in Fig. 162.

FIG. 166. — Detail of the Sliding Front.

FIG. 167. — Section Through Window and Sliding Front.

Set the completed refrigerator upon the outer window-sill, and secure it with wires from

the front corners to the window-frame. If there are any large cracks in the boxes, they should be covered with heavy paper, to keep dirt, rain and snow from blowing in. A hole should be bored through each end of each compartment for air-vents. Small cracks should be puttied, and the wood should be given a good coat of paint to keep it in condition.

A Windmill Clothes-Dryer. The clothes-dryer shown in Fig. 163 has been in use for a number of years, and, except

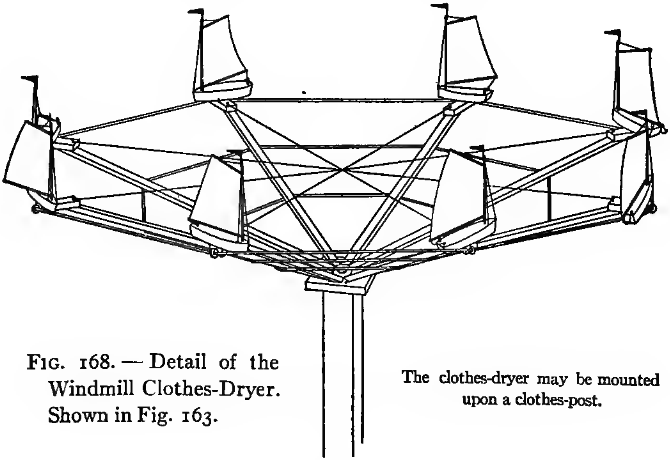


FIG. 168. — Detail of the Windmill Clothes-Dryer. Shown in Fig. 163.

The clothes-dryer may be mounted upon a clothes-post.

when not a breath of air is stirring, its little fleet of yachts, whose sails form the paddles of the windmill, sail around the circular course continuously. It is a practical toy that will serve the laundress excellently on wash day.

If there is a clothes-post in the center of the yard, its top may be used for a support; otherwise, you will have to put up a post. A 2-by-4 will serve the purpose. Set it

about 18 inches into the ground, and then brace it at the base with diagonal pieces. The base shown in Fig. 163 is more or less elaborate, but is all the more substantial for being so well braced.

Strips 1 inch thick and 2 inches wide may be used for the arms of the windmill dryer, but if you can get pieces 2 inches thick they will of course be so much the stronger. Cut the arms 6 feet long, and bevel their ends as shown at *A* (Fig. 170), cutting the lower ends to fit the base-board *B*, and the upper ends to fit the blocks *C*. The upper ends of the arms should be about 24 inches higher than the lower ends, which will determine the angle of the bevels.

Cut the base block *B* 8 inches square, and bore a ¾-inch hole through its center for the king-bolt *D*. Cut the blocks *C* about 2½ inches wide by 8 inches long. Nail blocks *C* to the upper ends of the arms, and drive the nail *E* into each block near the inner end. Either bolt or screw the lower ends of the arms to block *B*, spacing the arms as shown in Fig. 169.

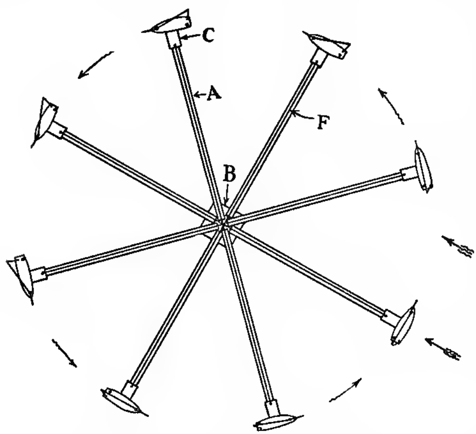


FIG. 169. — Plan of Windmill Clothes-Dryer.

Fasten with only one bolt or screw, first, then connect nails

E on each opposite pair of arms with the wire brace *F* (Fig. 170). These wires should be cut about 12 inches longer than the distance between the nails, and should be twisted back on themselves at one end as shown in Figs. 170 and 171; then a nail can be slipped through one of the loops and be used as a lever to twist the wire to take up the slack, when adjusting the arm ends to the proper level. The distances between the arm ends should be measured carefully, and the arms shifted from side to side until these are all the same; then fasten the bottom ends securely with a second bolt or screw.

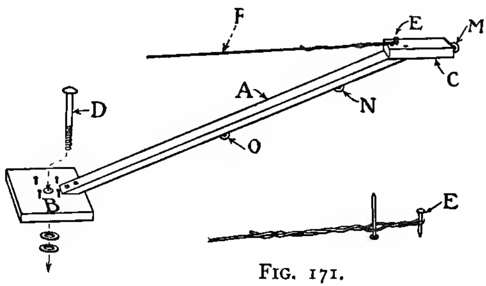


FIG. 170.

FIG. 171.

FIG. 170. — Detail of Arm and Base.
FIG. 171. — Wire Brace.

The hulls of the little yachts need not be made as perfectly as would be necessary for sailing in water; but, for the sake of appearance, it is well to make them as shapely as possible. They can be cut quickly. Figure 172 shows a top view of a hull, with the dimensions marked upon it. Make the bottoms flat enough to provide a nailing surface for fastening to the blocks *C*. Cut the *mast G* and the *boom H* each about the length of the hull, and the *gaff I* about 7 inches long; and fasten wire loops to the ends of both boom and gaff, as shown in Fig. 174, to fit over the mast.

A brad driven through the mast, just below the proper heights for the boom and gaff, will prevent the loops from sliding down the mast. Use heavy muslin for the sails, and attach the sails to the mast, boom, and gaff sticks with strong linen thread. Brace the mast as shown, and fasten a small cloth pennant to the mast-head.

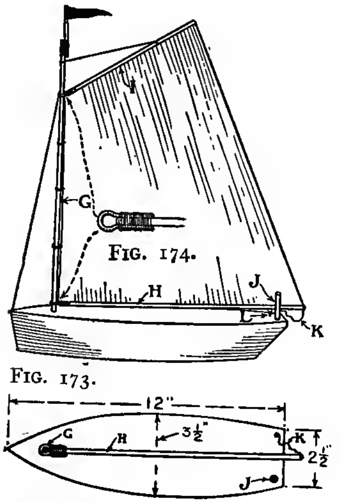


FIG. 174.

FIG. 173.

FIG. 172.

FIGS. 172–174. — Details of Yachts for Windmill Clothes-Dryer.

The peg *J* (Figs. 172 and 173) is necessary to prevent the boom from swinging over the port side of the yacht. By this arrangement, the yachts will always sail *counter clockwise*, no matter which way the wind is blowing, provided you mount them with their bows headed in this direction (Fig. 169).

Pivot the base block *B* to the post support with a ⅝-inch carriage-bolt about 5 inches long. Bore a ⅝-inch hole in the top of the post to receive the end of the bolt, and, in mounting the base block *B*, place several washers between it and the post. Screw ½-inch screw-eyes into the ends of blocks *C* (*M*, Fig. 170), and also into each of the arms at *N* and *O* (Fig. 170), to slip clothes-lines through. It is not necessary to cut a clothes-line into pieces, because after running it through

one row of screw-eyes it may be run down to the next row below, and so on through all the screw-eyes.

A Soap-Grater such as is shown in Fig. 175 is a very handy laundry convenience for grating soap for the wash-boiler on wash day. You can complete one in less than half an hour's time, because it requires nothing more than a frame made similar to that shown in Fig. 176, with a

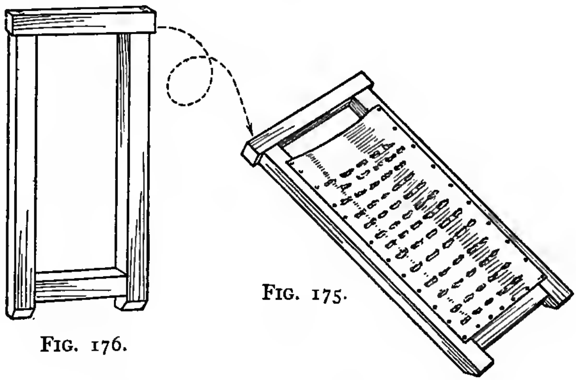


FIG. 176.

FIG. 175.

FIGS. 175 and 176. — A Laundry Soap-Grater.

perforated piece of tin tacked to it. The tin from a tomato-can will do, and the right size of perforations can be made with the end of a screw-driver. Lay the piece of tin upon a board, and drive the screw-driver through it into the board. Tack the tin to the frame. The wood of the soap-grater should be shellacked or painted.

A Broom-Rack. The construction of the broom-rack shown in Fig. 177 requires but little description, as it is made in one piece, and all of the dimensions for that are

shown in Fig. 178. To cut the slot, first bore a 1-inch hole at each end of the space, and then cut out the wood between with a small saw. Bore a hole at the three places marked *H* (Fig. 178), for screws, and in putting up the rack screw it to the kitchen chair-rail or to the back of a door.

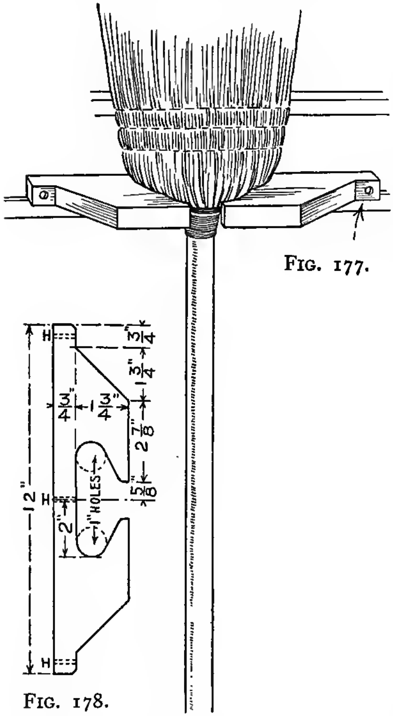


FIG. 177.

FIG. 178.

FIGS. 177 and 178. — A Broom-Rack.

Figure 179 shows

A Bath-Room Toilet-Cabinet that can be made out of a grocery box and a few additional box boards. The box shown in the illustration is 16 inches wide and 18 inches high, when stood on end, and its inside depth has been reduced to 4 inches by sawing through the ends and sides of the box, and using the lower portion. Fasten together the cover boards with battens screwed across them near the ends, for the door, and hinge this to one side of the cabinet, as shown.

To the top of the box nail a board large enough to make

a projection of 1½ inches over the front and ends, and fasten another board of the same size to the bottom. At the back of the cabinet, fasten a board 4 inches wide to the under side of the bottom board, and between this and the bottom board screw two brackets cut similar to that shown in Fig. 180. The hole shown in the side is bored to receive a stick for a towel-rack, for which a broom-handle may be

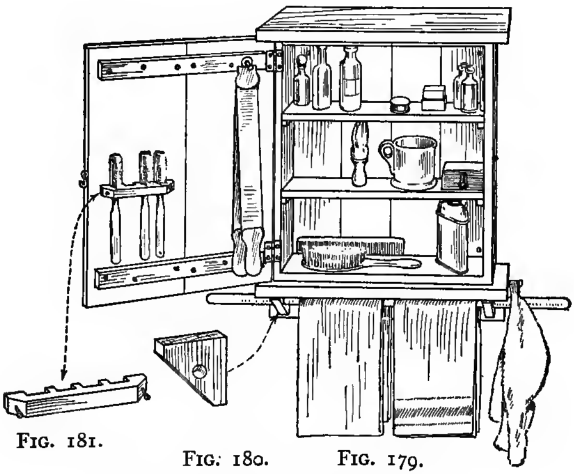


FIG. 181. FIG. 180. FIG. 179.

FIG. 179. — A Bath-Room Toilet-Cabinet.
FIG. 180. — Bracket for Towel-Rack.
FIG. 181. — Toothbrush-Rack.

used. The ends of the towel-rack may be allowed to project 6 or 8 inches beyond each end bracket.

Nail two cleats to each side of the cabinet, on which to support the two shelves, placing them so the spaces between the shelves will be the same. Figure 181 shows how

to prepare a toothbrush-rack for the inside of the cabinet door. Screw a mirror to the front of the door. The toilet-cabinet will look best painted with white enamel. Give the wood several coats of the enamel.

A pot-closet is seldom provided in an apartment, and, unless the pantry contains lower cupboards, the house-

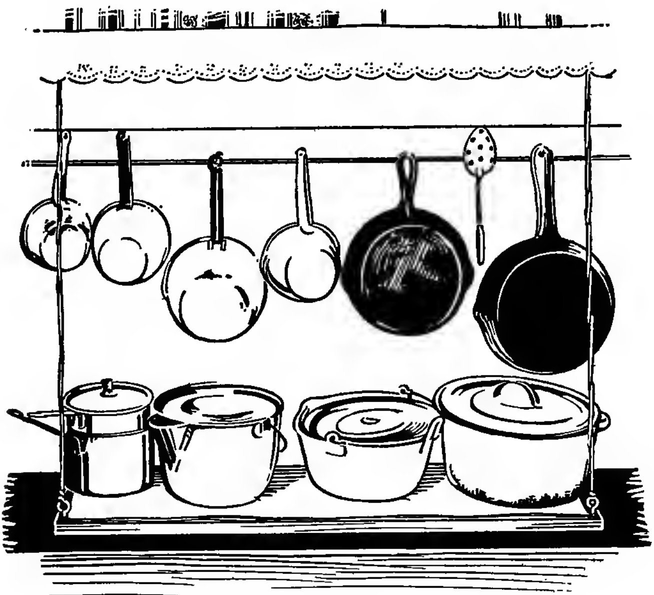


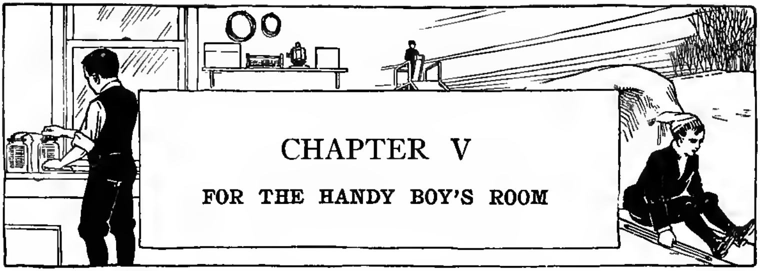
FIG. 182. — A Pantry Shelf for Pots and Kettles.

keeper has a hard problem in finding suitable places to keep her pots and kettles. To set cooking utensils upon the floor, where they will catch the particles of dust which blow in under the none too well fitting pantry door, is untidy, and another objection to this arrangement is that

each time the pantry floor is washed or brushed up, they must be moved.

Figure 182 shows how by adding

A Pot Shelf at the height of the base-board, which is high enough above the floor to admit a broom or mop beneath, provision can be made for the pots and kettles. A board 10 or 12 inches wide should be obtained for the shelf. Nail the back edge of this board to the top of the base-board, and support the front edge from the pantry shelving, by means of wire hangers, as shown in the illustration. The wires should be attached to screw-eyes set in the board near its ends, and in the under side of the shelving. By suspending the shelf in this way, there will be no obstruction beneath. If the shelf can be placed across one end of the pantry, so each end can be supported upon the top of the base-board, the wire hangers will not be necessary.



CHAPTER V

FOR THE HANDY BOY'S ROOM

Every handy boy takes pride in fixing up his room and constructing home-made furniture for it, and no matter how poor his working material may be he usually manages to transform it into things that are practical for his purposes. The handy boy's room containing such furniture approaches nearer to the ideal than one fitted up entirely with store furnishings.

A Writing-Desk like the one in Fig. 183, with a wide *drop-leaf* to write upon, plenty of *pigeon-holes* in which to place letters, school papers, and catalogues of boats, toys, athletic goods, etc., that you wish to keep near at hand, and a *drawer* for writing materials, is just what you need for your bedroom. The drawer is really misnamed, because the one in this desk does not pull out, but is reached

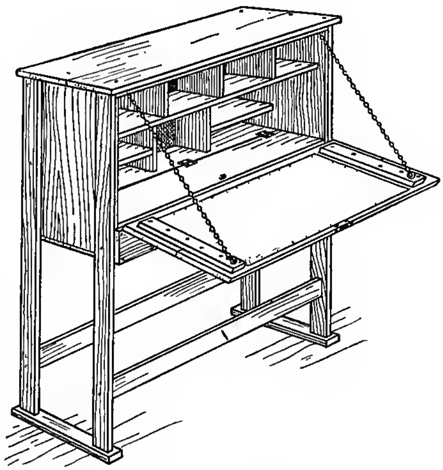


Fig. 183. — A Writing-Desk.

by raising a *hinged-leaf* (*E*, Fig. 186). However, it serves the same purpose, and besides being easier to construct is handier to get at when the drop-leaf is open.

A small packing-case from the storeroom, grocery, or dry-goods store, and a few boards from the kindling pile or another box, will be needed for the desk.

After renailing all boards that show signs of loosening, cut two strips of wood 3 inches wide and of a length equal to the inside depth of the packing-case. Fasten these in the ends of the box as shown at *A* and *B* (Fig. 184). Then cut a strip equal to the length of the box, and of the width of *A* and *B* plus the thickness of the side of the box, and nail it to the top of the box (the desk front) on a level with strips *A* and *B* (*C*, Fig. 185).

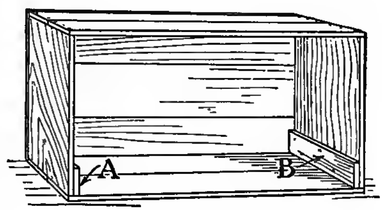


FIG. 184.

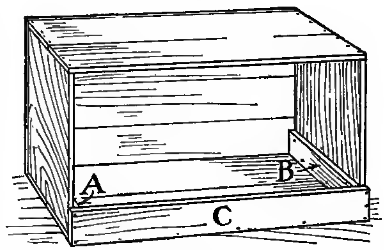


FIG. 185.

FIGS. 184 and 185.—First Steps in Making the Writing-Desk.

The lower compartment is covered with boards *D* and *E* (Fig. 186), each of which should have a width equal to one-half the inside depth of the box. Board *E* should be hinged to the edge of board *D*, and the latter should be nailed in place to the top edge of strips *A* and *B*. Fasten a brass ring to board *E*, near the front edge, by

means of a small staple, to catch hold of in lifting the leaf (Fig. 186).

Partition off the box into *pigeon-holes*, using as thin wood as you can get for the purpose. Figure 183 will furnish you with a suggestion as to how it may be done, but you may space them in any other way that you wish. The top row can extend out to the front of the desk, but the lower pigeon-holes must be kept far enough back of the hinged-leaf *E* so they will not interfere with it opening.

The front drop-leaf (*F*, Fig. 187) should be made from the cover boards, battened together on the inner face, and

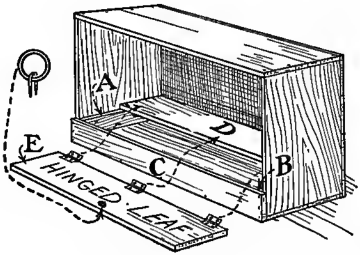


Fig. 186. — Detail of Lower Compartment.

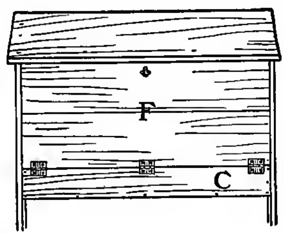


Fig. 187. — The Completed Desk with Drop-Leaf Closed.

it should be hinged to board *C* as shown in Fig. 187. A desk *mortise lock* (Fig. 120), or a *half-mortise lock* (Fig. 121), can be purchased at a hardware store for 15 or 20 cents, and by examining any piece of cabinet work having such a lock you will understand how the lock should be put on. To keep the drop-leaf from dropping below the proper writing level, support it with pieces of brass chain (Figs. 92 and 93), or tape, fastened to screw-eyes screwed into the

battens of the drop-leaf and the inside of the desk-top. To conceal the roughness of the boards used for the drop-leaf, tack either a piece of table oilcloth or heavy wrapping-paper over the inside face of the boards.

The height of the opened drop-leaf of a desk should be that of a table — usually 2 feet 5 inches. This dimension must be used in determining the length of the four leg strips. These strips should be 2½ inches wide. Nail them to the four corners as shown in Fig. 183, being careful to get the lower projecting portions of equal lengths; then cut two wooden blocks for *shoes*, and nail one to each end pair of legs. The shoe blocks should be of the proper dimensions so there will be a projection of about 1 inch outside of the legs. The shoes will brace the legs and, at the same time, will rest more solidly upon the floor than would the four narrow legs. Fasten two horizontal braces between the legs, one in front and the other in back, as shown in Fig. 183. These strips should be 2½ inches wide.

Cut enough boards of the proper dimensions to form a desk-top with a projection of 1 inch over the box all around. These boards will conceal the tops of the leg strips. When they have been nailed in place, the last constructive detail necessary to transform the packing-case into an attractive desk will have been completed.

Drive all nail heads below the surface of the wood, then putty up these little holes, and all joints and cracks. If the box is stamped with a manufacturer's trade-mark or other printing, remove it with sandpaper — that is, in case you

wish to stain, shellac, or varnish the wood. If you use paint this will not be necessary, because two thorough coats will be opaque enough to conceal these blemishes.

A Combined Desk and Bookcase such as is illustrated in Fig. 188, is most convenient, as school-books, a dictionary, and other books of reference can be kept close at hand while lessons are being prepared. This piece of home-made furniture can be constructed entirely of boxes and box boards, and if the wood is carefully put together and then neatly finished, it will look almost as well as if it had been made of new boards.

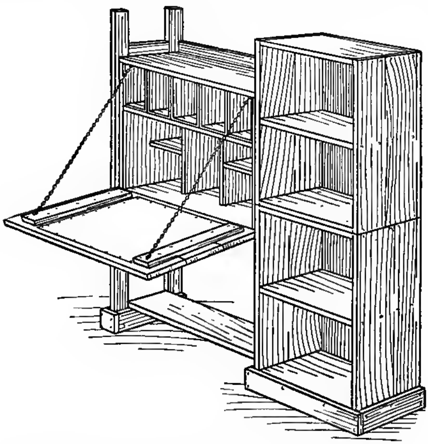


Fig. 188. — A Combined Desk and Bookcase.

Two grocery boxes or small packing-cases, about 30 inches long, 20 inches wide, and 12 inches deep, are needed for the bookcase, and a box approximately of the same length and width, but 1 inch less in depth, for the writing-desk. If you cannot get boxes of the right sizes, it will be an easy matter to cut down larger boxes. Renail all boards that show signs of coming loose, and remove any pieces that are badly split or that have knot-holes in them, and replace them with boards from another box.

Set the boxes of the bookcase one on the other, end to end, and screw them together. Then divide each box with a shelf half-way between the ends. Cleats may be nailed to the sides of the boxes to support the shelf boards, or you can nail through the sides into their ends. Nail strips 3 inches wide around the bottom of the lower box for a base.

The end of the writing-desk box should be screwed to the side of the bookcase, with its back even with the back of the bookcase, and the top about 8 inches below the top of the bookcase.

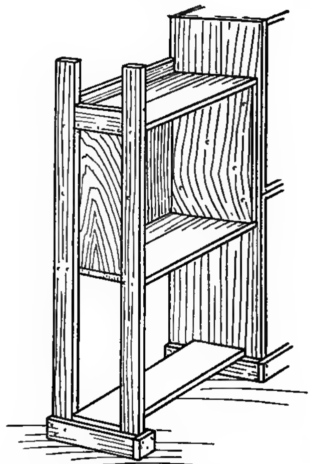


FIG. 189. — Detail of Desk End.

Figure 189 shows how the outer end of the desk is supported upon uprights. These uprights should be 3 inches wide and as long as the bookcase is high. Before nailing them to the desk, fasten the lower ends at the proper distance apart with 3-inch strips nailed to their sides and across the ends. These strips will make a base that is uniform with that around the bottom of the bookcase, and at the same time will make a more solid support than the two ends of the uprights would. A board may be extended from the top of this end support over to the bookcase base, for a foot-rest, and by fastening a horizontal strip between the two end uprights, and another between the rear one

and the bookcase, as shown in Fig. 189, the top of the desk will make a good shelf.

Divide the desk into pigeon-holes by vertical and horizontal partitions. Cigar-boxes, with one end removed and the cover nailed on, will do excellently for the top row of pigeon-holes (Fig. 188).

Fasten together the cover boards of the desk box with two battens placed near the ends, for a *drop-leaf*. Fit a narrow strip between the bookcase and the front end support, close up against the desk bottom, for a *hinge-strip*, and hinge the drop-leaf to this. The outer portion of the drop-leaf must be supported by means of chains fastened to small staples driven into the under side of the desk-top and into the drop-leaf battens.

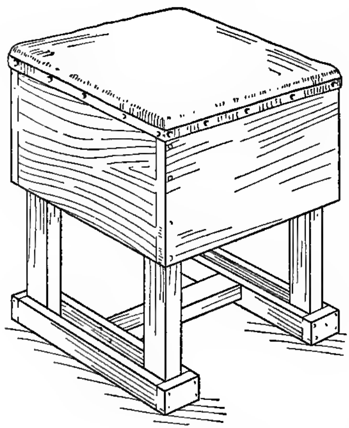


FIG. 190. — A Desk Stool.

Tack either a piece of oilcloth or heavy wrapping-paper over the inside of the drop-leaf, to cover the joints between the boards and make a smooth writing surface.

The Desk Stool in Fig. 190 has a soap-box seat, and legs constructed similar to the end supports of the writing-desk just described. Make the uprights 1½ inches wide and 1 inch thick, and the base strips about 1½ inches wide and ½ inch thick. Fasten a crosspiece between the base sup-

ports for a brace. The top of the seat should be padded with cloth or excelsior, and then covered with denim, cretonne, or imitation leather. The covering material should be brought down over the sides of the seat and be tacked in place; then for a finish fasten gimp around the edge with large tacks.

Finish the woodwork of the stool to match that of your writing-desk.

A Book and Magazine Rack. The top shelf of the rack shown in Fig. 191 may be used for books and magazines, and the bottom cupboard to hold supply catalogues, and odds and ends.

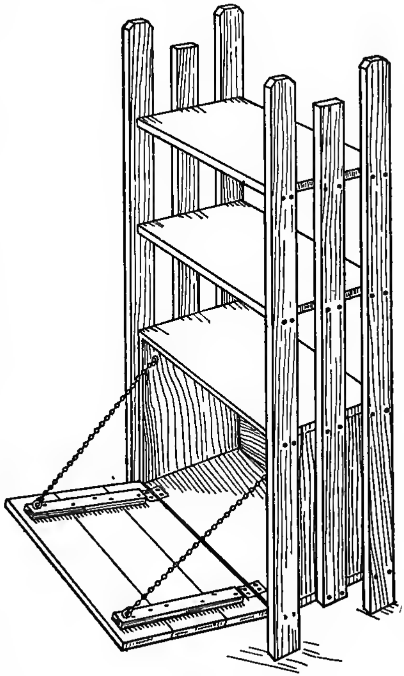


Fig. 191.—A Book and Magazine Rack.

Procure a grocery box for the lower cupboard, and, after cutting the four corner uprights about 3 feet 6 inches long and 3 inches wide, out of some packing-case boards, screw or nail them to the ends of the box, with the lower ends projecting 4 inches below the box, and the edges of the front pair projecting 1 inch beyond the front of the box. Cut the center side strips 8 inches shorter than the corner uprights, and fasten them to the box ends with

their bottoms even with the box bottom. Trim off the corners of the tops of the corner uprights as shown.

If you cannot get boards that are wide enough for the shelves, two pieces may be battened together on the under side for each shelf, or cleats may be screwed to the uprights to support their ends. Space the shelves at equal distances apart.

Batten together the cover boards of the box compartment, for a *drop-leaf*, and hinge this to the lower edge of the box. Suspend its outer edge by means of two chains, to support it when open.

A soap box is of just the right size for

A Blacking-Case (Fig. 192). Cut two strips for each leg, making one 3 inches wide and the other as much nar-

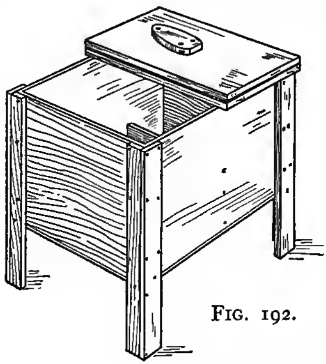


Fig. 192.

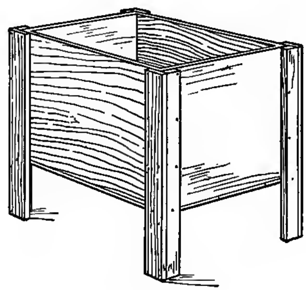


Fig. 193.

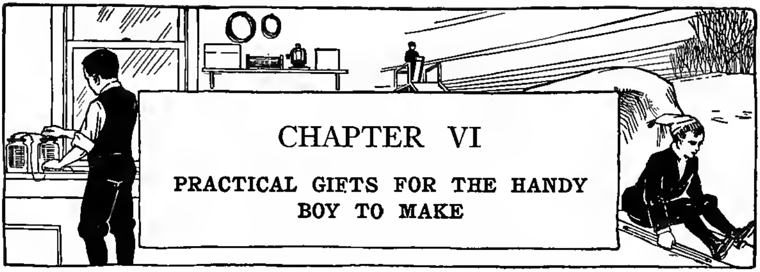
Figs. 192 and 193. — A Blacking-Case.

rower as the thickness of the wood. Nail the face of each wide strip to the edge of each narrow strip, and then fasten one leg to each corner of the box, as shown in Fig. 193.

The top should be made of two pieces, of the proper size to form a projection of 1 inch over the sides of the box.

One of these pieces should be nailed in place, and the other should be hinged to it. Fasten a block of wood to the inside face of the hinged board, for a foot-rest. Use the sole of your shoe for a pattern for this block.

Divide the inside of the box with a center partition (Fig. 192), so one half of the box may be used for cans of shoe-polish and bottles of dressing, and the other half for brushes and polishing rags.



CHAPTER VI

PRACTICAL GIFTS FOR THE HANDY BOY TO MAKE

The articles illustrated in this chapter have been selected because of their usefulness and the ease with which a handy boy can make them. They are small articles, of just the right size for Christmas and birthday gifts, and among the variety of ideas presented will be found something suitable for every relative and friend whom you wish to remember.

The Materials required cost so little, that any one of the articles is inexpensive to make, and as all are of very simple construction they can be made quickly. Pine, whitewood, basswood, and oak are the best woods to use, and if you want only enough material for one or two articles you can generally get it from a carpenter. Oftentimes, a carpenter has large enough pieces in his scrap pile to serve the purpose, and these he will generally gladly let you have if you will take the trouble to pick them out.

There are a variety of

Methods of Finishing woodwork, but for small articles nothing is nicer than a stain and wax finish. Prepared wood stains of all colors can be purchased in small quantities at any paint store, and by watching the magazine advertisements you will often find an opportunity to obtain free samples containing stain enough to finish several articles.

The woodwork should be sandpapered smooth, and free from saw and plane markings; then the stain should be applied, and, after it has dried, a couple of coats of wax should be rubbed over the surface to give it a semi-gloss finish. Complete instructions accompany these prepared stains.

An open-grained wood, such as oak, is often *filled* after it has been stained; that is, the wood is brushed over with a liquid which fills up the grain flush with the surface; but filling is unnecessary for small articles, and really detracts from their appearance, because it conceals, more or less, the pretty markings of the grain.

The Thermometer-Board illustrated in Fig. 194 is a very practical little article that is needed in every house. The back board should be made of wood about 3/8 inch thick. Figure 199 shows a pattern of this, with all the necessary dimensions for laying it out. First, draw the center-line as shown, then lay off the measurements each side of the line; this is the easiest way to get both sides alike. The curved ends should be cut with a small saw — a scroll-saw, a bracket-saw, or a coping-saw — and then be smoothed off with a wood file and sandpaper. Bore a small hole through the board, near the top, for hanging it up. Do this before you have cut out the end; then there will be less danger of splitting the wood. You may screw a small brass screw-eye into the top of the board instead of boring the hole, if you wish.

The little metal strip holding the thermometer can be

purchased at any large stationery store, or department store, and will cost 15 or 20 cents, and a small calendar-pad can be purchased for a few cents at the same place. The thermometer for this size of board should be about ¾ inch wide and 5¾ inches long, and the calendar 1¼ inches wide by 1¾ inches long. If you cannot find a thermometer and a calendar of these proportions, it may be necessary to alter the dimensions of the board, because the margin around them should be about the same as it is in the photograph (Fig. 194). Fasten the thermometer and calendar-pad to the board with brads. As the glass bulb and upper end of the thermometer generally project a trifle beyond the back of the metal strip, it will be necessary to hollow out places in the board for them to set into.

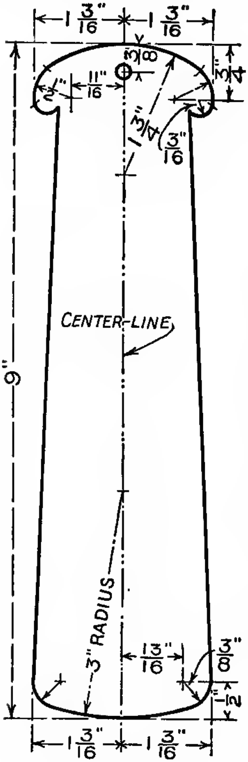


FIG. 199.—Detail of Thermometer-Board Shown in Fig. 194.

The Key-Board shown in Fig. 195 should be made of a piece of wood ⅜ inch thick, by the other dimensions shown in the pattern (Fig. 200). After laying out, cutting, and planing up this piece, mark off a bevel ¼ inch wide around the face edges, and cut it with your plane.

Lay off the positions for the hooks, following the measure-

Fig. 194.
A Thermometer-board.

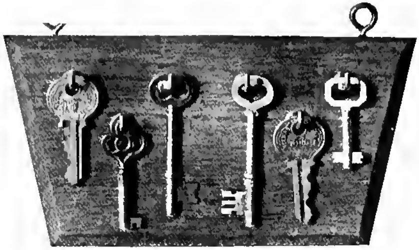


Fig. 195.—A Key-board.

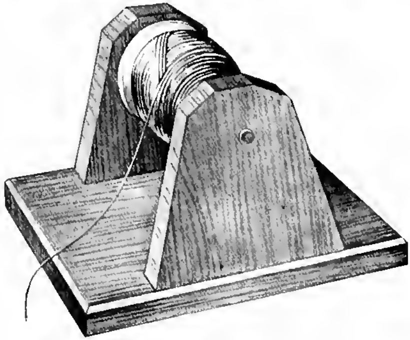


Fig. 196.—A Spool Holder.

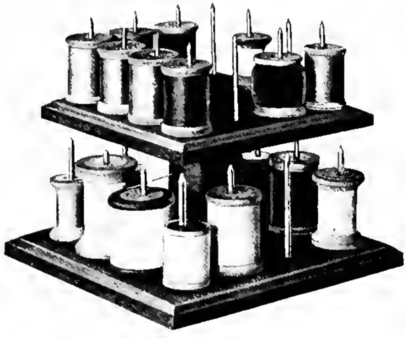


Fig. 197.—A Spool-Rack.

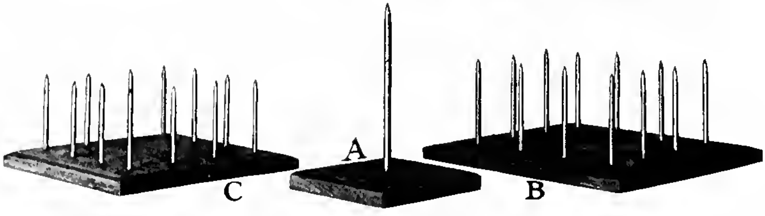


Fig. 198.—The Three Parts of the Spool-rack.

ments given in Fig. 200, and then start the holes in these positions with a brad-awl. The screw-hooks should be similar to that shown in Fig. 83, page 56, and about 1 inch in length. Screw screw-eyes into the top edge of the board, by which to hang it up.

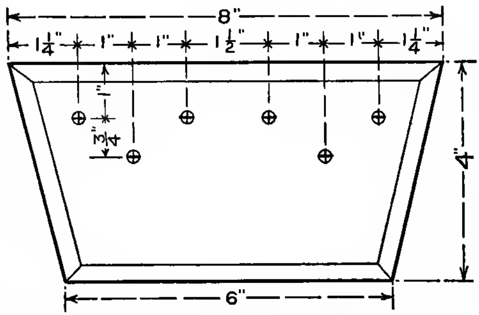


FIG. 200. — Detail of Key-Board Shown in Fig. 195

A Spool-Holder such as shown in Fig. 196 will be appreciated by any woman who crochets, because it not only allows the thread to unwind freely, but prevents the spool from rolling off on to the floor.

The spool-rack should be made of wood not over ⅜ inch thick, and even cigar-box wood is not too thin. The base of the holder should be made of the size shown in Fig. 201. Bevel its top edges. The pattern for the end pieces is also shown in Fig. 201. Bore a hole in each large enough for a 4½-inch nail to slip through. This nail forms an axle for the spool to turn upon.

A Spool-Rack like the one shown in Fig. 197 will be a great convenience to mother or sister, because it will hold as many as twenty-six of her spools of thread, each within easy reach when wanted. The upper and lower shelves of the rack are pivoted so as to turn on the base block, and, by this arrangement, when the rack is placed upon a table,

either shelf may be turned until the size of thread wanted is nearest. The rack is heavy enough to keep its position while thread is unwound from a spool.

Cut the base block *A* (Fig. 198) 3 inches square, *B* 6 inches square, and *C* 5 inches square; and bevel the upper edges of each. The center pin of block *A* is a 4-inch wire nail, the pins of block *B* are 2½-inch nails, and the pins of block *C* are 2-inch nails. With a gimlet or drill, bore holes

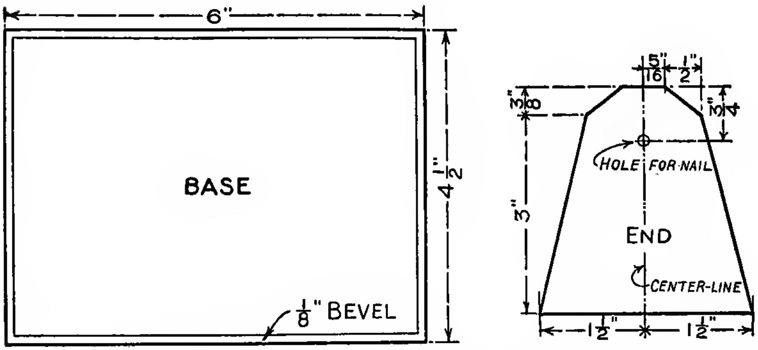


FIG. 201. — Details of the Spool-Holder Shown in Fig. 196.

a trifle smaller than the nails through the three blocks before driving in the nails, so the wood will not split. Lay off the positions for the nails with a ruler, first drawing a line around block *B* 1 inch away from the four edges, and another around block *C* ¾ inch away from the edges. The center pin should fit loosely enough in the holes in *B* and *C* so the blocks will turn easily upon it.

A large spool should be slipped over the center pin, be-

tween blocks *B* and *C*, to support *C*. The upper rack must be lifted off to slip on or off the spools from the lower rack.

A Simpler Spool-Rack than the above may be made by omitting the upper block *C*

A Paper-Spindle on which to file grocery bills, receipts, etc., for safe keeping, may be made similar to base *A* of the spool-rack (Fig. 198). The nail pin of this must be filed to a long, sharp point, so it will pierce papers easily.

A Necktie-Rack. Lay out the back board of the necktie-rack shown in Fig. 202 by the pattern of Fig. 207; then

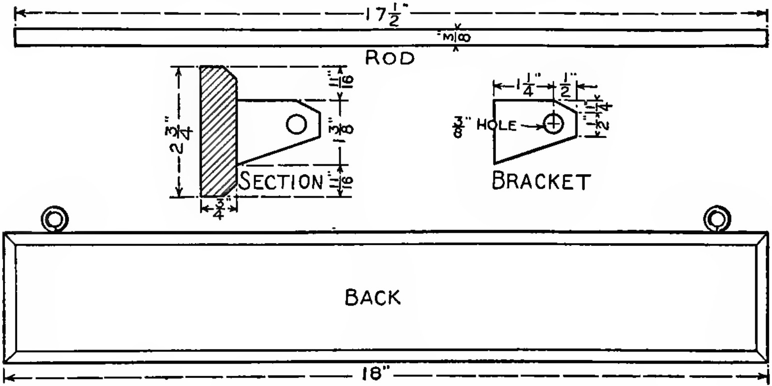


FIG. 207. — Details of Necktie-Rack Shown in Fig. 202.

the two end brackets by the details of the same drawing. Bore a ⅜-inch hole through each bracket for the rod, before cutting out the pieces; this will lessen the danger of splitting when boring. Bevel the face edges of the back board as shown. The necktie rod may be a cabinet-maker's *dowel-stick*, or a piece of a small flag-staff.

Fasten the rod brackets to the back board 11-16 inch from the ends, using short finishing-nails and glue; then coat the rod ends with glue, and slip them through the holes in the supports. Screw the two hanging screw-eyes into the top edge of the back board, centering them on the centers of the rod brackets.

The Match-Box shown in Fig. 203 is made out of cigar-box wood. Figure 208 shows the pattern for the back,

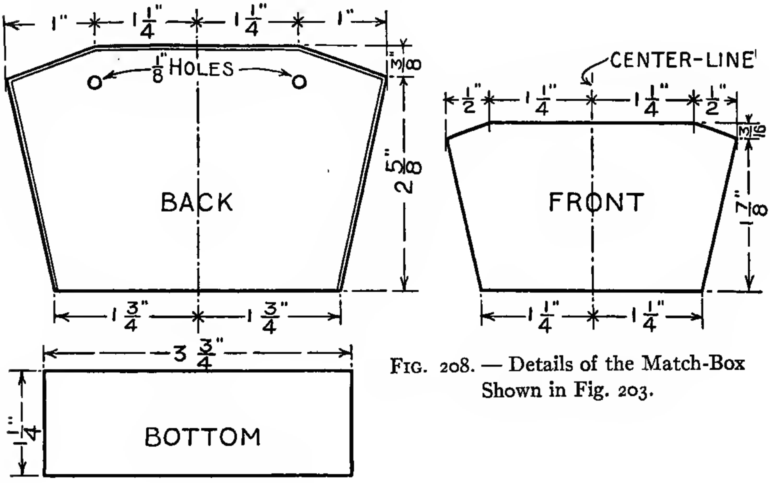


FIG. 208. — Details of the Match-Box Shown in Fig. 203.

front, and bottom pieces. Cut the ends and the center partition ¾ inch wide and 1 15-16 inches high. Bevel the face edges of the front and base pieces, and bore two ⅛-inch holes through the back pieces as a provision for hanging up the box. Small bevels like those on the back and base pieces are best made by wrapping a piece of sand-

FIG. 202.—A NECKTIE-RACK.

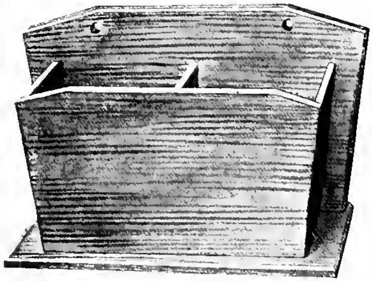


FIG. 203.—A MATCH-BOX.

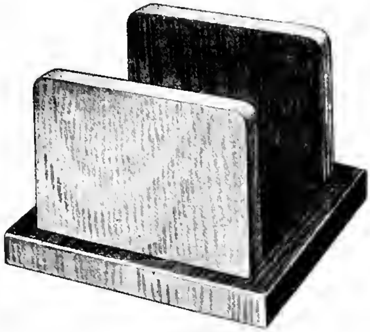


FIG. 204.—A POST-CARD RACK.

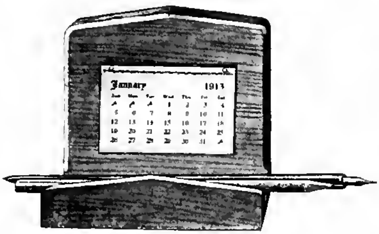


FIG. 205.—A PEN-TRAY AND CALENDAR-BOARD.

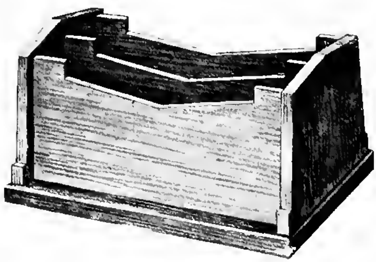


FIG. 206.—A LETTER-RACK.

paper around a block of wood and using the block like a plane.

After the pieces have been cut and sandpapered, fasten them together with glue and small brads. This match-box is of good proportions for kitchen use.

A Post-Card Rack. The little rack in Fig. 204 is handy for keeping together the souvenir post-cards, birthday cards, and holiday cards received by the family, and, if placed upon the library table, the cards will be within convenient

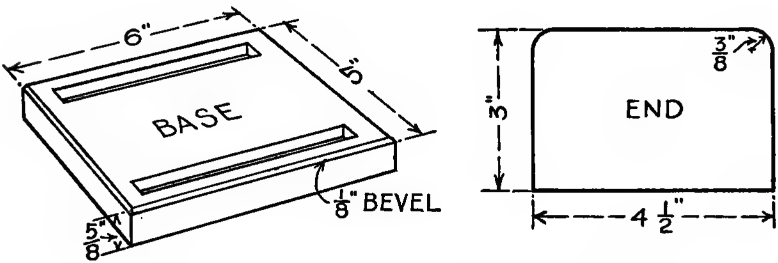


FIG. 209. — Details of Post-Card Rack Shown in Fig. 204.

reach for showing to friends. The post-card rack is a good gift for sister.

Figure 209 shows the completed base of the rack, with the dimensions for cutting; also the pattern for the end pieces. The base may simply be nailed to the end pieces, but it makes a more solid rack to *mortise* the base as indicated in the drawing, to receive the bottom edges of the end pieces. Glue the ends in the mortises, and also drive a few brads through the base into them. The rounding of the corners of the end pieces can be done easiest with a

chisel. Lay the pieces flat upon a board, and then *pare* down the corners until you reach the finish line. Smooth up the edges with sandpaper.

The Calendar-Board and Pen-Tray in Fig. 205 will be appreciated by any owner of a writing-desk, and it is an attractive article for a library table.

Figure 210 shows the pattern for the calendar-board, and the front and bottom of the pen-tray. These pieces should

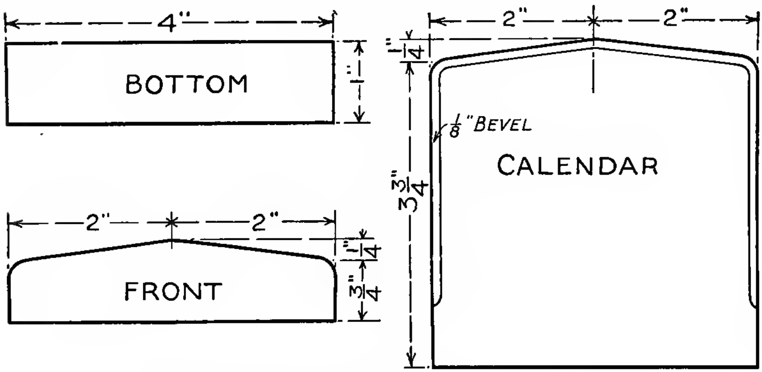


Fig. 210. — Details of Pen-Tray Shown in Fig. 205.

be 3/8 inch thick. The bottom piece fits between the calendar-board and the front of the pen-tray. Bevel the face edges of the calendar-board, beginning the bevel 3/4 inch above the bottom edge, as shown in Fig. 210.

The calendar-pad shown in Fig. 205 is 2½ inches long by 1¾ inches wide. This is a standard size, and bears the right proportions to the calendar-board. If you cannot get one like it, change the dimensions of the calendar-board

so there will be about the same margin of wood around the pad that there is on the board illustrated. Fasten the pad at each of its upper two corners with a tack.

A Letter-Rack is a convenient article for the writing-desk or library table, and the rack illustrated in Fig. 206 is of a

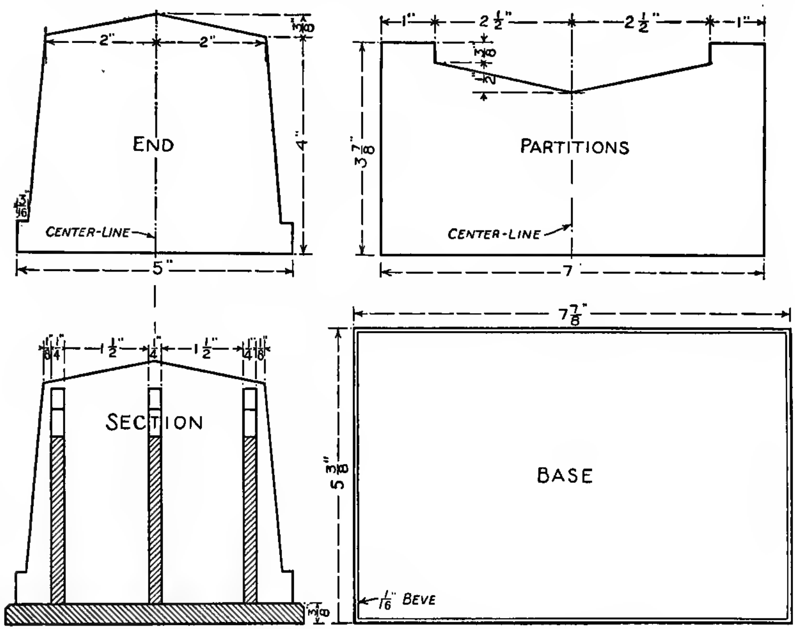


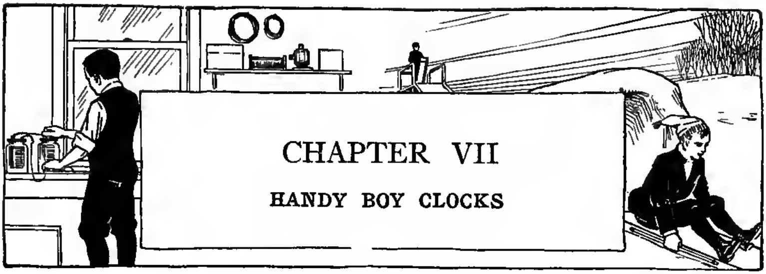
FIG. 211. — Details of Letter-Rack Shown in Fig. 206.

unique design. Notice that the top edge of the partitions of the rack follow the lines of the edge of an envelope flap.

The base of the letter-rack should be ⅜ inch thick, and the partitions and ends should be ¼ inch thick. Lay out all the pieces by the dimensions on the patterns shown in Fig.

211, drawing center-lines across the irregular pieces, and laying off the measurements each side of these.

Fasten the end pieces to the partitions, first, with glue and brads; then fasten the base to their bottom edges. The sectional drawing in Fig. 211 shows the correct spacing for the partitions.



CHAPTER VII

HANDY BOY CLOCKS

THE best kind of a clock for a sound-sleeping boy who has difficulty in awakening on time is an electric alarm-clock which will not only arouse him, but keep on ringing until he gets up and turns off the lever that shuts off the electric current. Just such a clock as this is shown in Fig. 212.

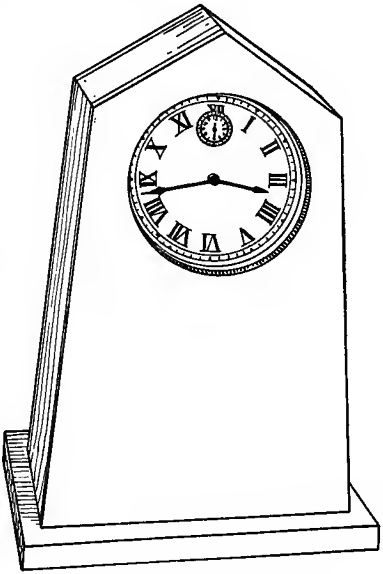


FIG. 212. — An Electric Alarm-Clock.

You will see by examining the details of this electric clock that it is very simple to make. Almost any kind of an alarm-clock can be used; but for a clock designed similar to that in Fig. 212, it should be of the common round form shown in Fig. 214. If you own a clock of a different kind, you can change the design of the wooden case to suit it.

Figure 213 is a pattern for the front and back of the wooden case illustrated. In

order to get the sides of these pieces alike, first draw a center-line as shown; then lay off the measurements each side of this. Box boards 3/8 inch thick will do for material. The opening for the clock should be cut through each piece before the pieces themselves are cut out, so as to leave as much margin around the hole as possible; this

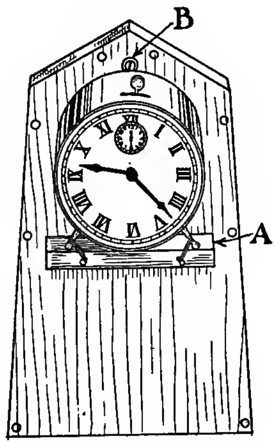


Fig. 214. — Back Piece with Clock Attached.

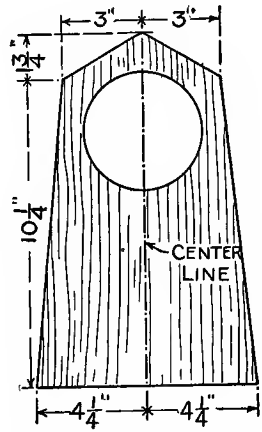


Fig. 213. — Patterns of Front and Back.

will lessen the danger of splitting the wood in cutting the hole. Bevel the face edge of the hole cut through the front piece (Fig. 212).

The wooden case must be deep enough to hold a dry battery, and the diameter of the battery will govern the width of the side and top pieces; 3 inches is ample space for a dry battery of standard size. The lengths of the side

and top pieces will be determined by the front and back pieces already cut. Fasten the side and top pieces to each other and to the front piece, using finishing-nails for the nailing; then cut the base piece of the proper size to make a projection of ½ inch outside of the case all around, and fasten the case to it. The neatness of your work will depend a great deal upon the accuracy with which the ends of the side and top pieces are cut, so be careful in preparing them.

The alarm-clock is supported upon a narrow shelf fastened to the back piece (*A*, Fig. 214). The face of the alarm-clock should be set flush with the inside face of the front of the wooden case, and you must take this into consideration when fastening the clock to shelf *A*. If the clock is exactly as deep as the wooden clock-case, the ring at the top of the back of the clock can be screwed to the wooden back (*B*, Fig. 214); if not so deep, it will have to be blocked out from the back piece. The bottom of the clock is held to the shelf by wiring the legs to nails, as shown.

The battery should be placed in the bottom of the case, and the electric-bell should be screwed to the inside of the face, as shown in Fig. 215. Cut the wooden block *C* a trifle smaller in diameter than the inside depth of the case (Figs. 215 and 217); drive the nails *D* and *E* into the edge at right angles, as shown in Fig. 217; and screw the block through its center to the side of the case, on a line with the center of the alarm-clock (Fig. 215). Drive nail *F* into the side of the case ½ inch below block *C*, and in line with its

center (Figs. 215 and 217). Screw a switch, made like the one shown in Fig. 246, page 139, to the right-hand side of the clock-case (Fig. 216), and then connect one binding-

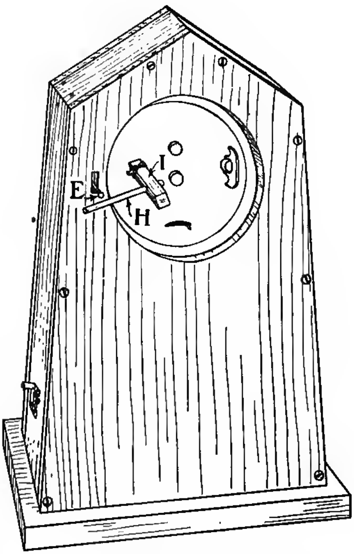


FIG. 216.—Rear View of Completed Clock.

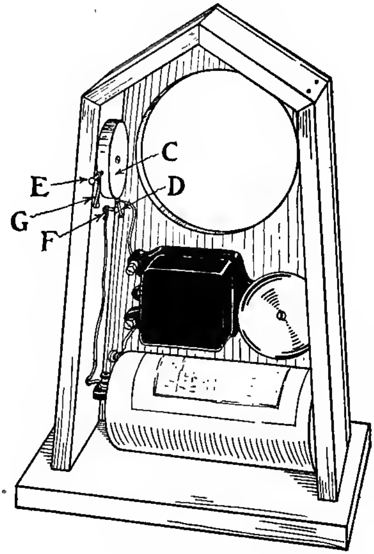


FIG. 215.—The Clock-Case Interior.

post of this switch with one of the battery binding-posts, and the other switch binding-post with the nail *F*. Also connect one of the bell binding-posts with nail *D*, and the other binding-post with the second binding-post of the battery. Use ordinary bell-wire for these connections.

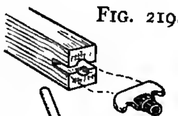
Now, with the switch *closed*, when nail *E* is pushed up, block *C* will turn, and when nail *D* strikes nail *F* the electric *circuit* will be closed, and the bell will ring. Fasten the

rubber-band *G* (Figs. 215 and 217) to nail *E*, and to another nail driven into the clock-case far enough below it to stretch the rubber-band to about one-half again its length. This rubber-band will break the electrical connection just as soon as the pressure on nail *E* is removed.

Cut a small slot through the back board of the case for nail *E* to stick through; and then fasten the board in place with screws so it can be removed easily if the bell, battery, or other mechanism requires attention.

All that is required to complete the mechanism is a lever extending from the alarm winding-key of the clock far enough over to the left to strike nail *E*, so that it will push up nail *E* and make connection between nails *D* and *F*. This lever (*H*, Fig. 216) may be a piece of brass rod, or a large wire nail. It must be fastened in a wooden post (*I*, Fig. 216), and the end of this post must be cut to fit over the alarm-key and be wired to it, as shown in Figs. 218 and 219. All clock alarm-keys do not turn in the same direction, when unwinding.

FIG. 219.



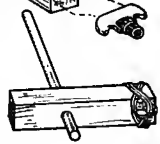


FIG. 218.

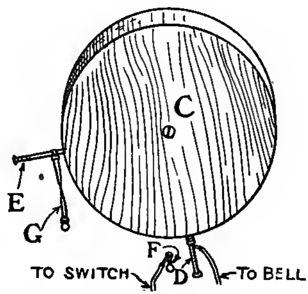


FIG. 217.

FIGS. 217–219.—Details of Mechanism Required to Operate the Electric Alarm.

If the key of your clock turns from right to left in unwinding, the lever *H* will press nail *E* down instead

of up, and that will not do with the arrangement illustrated; in this case, the contact nails *D* and *F* must be so placed that the contact will be made when nail *E* is pushed down.

To shut off the electric alarm in the morning, it is of course only necessary to turn the switch lever so as to break the electrical connection. But keep your clock far enough away from your bed, so there will be no temptation to throw off the switch and then "turn over."

A Unique Mantel Clock for the library can be made by enclosing a common alarm-clock in a wooden case. The attractiveness of such a clock depends entirely upon the design used for the case. This must be of good proportions, and simple, clean-cut lines will look the best.

Figure 220 shows a pleasing design, and Fig. 222 shows the working-drawings for the face, back, and end pieces. The alarm-clock for which this case was designed was 4½ inches in diameter; but the case has a greater inside width than this, and will probably accommodate any clock that you may have. The dimensions can easily be altered, however, if necessary.

Pine, whitewood, or basswood may be used for working material; but an open-grained wood such as oak is better for staining if you intend to put a stain finish on your work.

The opening in the front of the clock-case should be cut enough smaller than the clock so there will be a lap of about ¼ inch all around; while the hole in the back of the case must be of the exact diameter of the clock because

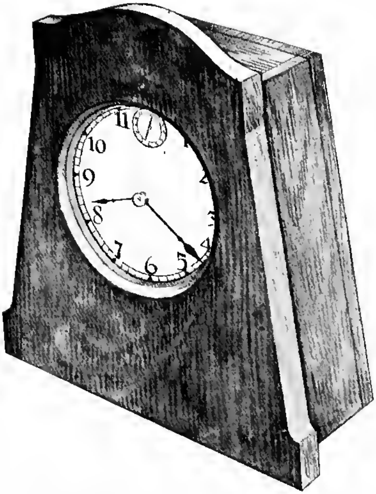


FIG. 220.—A UNIQUE MANTEL CLOCK.

FIG. 221.—A CLOCK FLASH-LIGHT.

the clock is fastened in this opening. These holes should be cut before the pieces are cut out, so there will be enough margin around the opening to preclude the possibility of

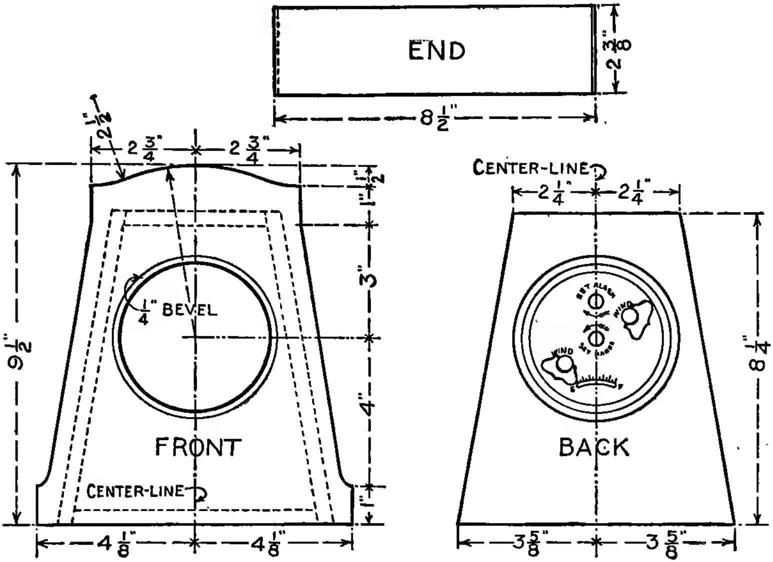


FIG. 222. — Details of Mantel Clock Shown in Fig. 220.

splitting the wood. The face opening is beveled to reduce the thickness of the wood at that point.

After cutting the end, top and bottom pieces, bevel their ends so they will fit together at the proper angles. To avoid nailing through the front of the case, in attaching it, fasten blocks in the four corners of the frame, and then screw or nail these to the inside of the front piece. Blocks must also be fastened to the front piece, above and below the opening, to support the alarm-clock.

A Clock Flash-Light is a great convenience, for by its aid you can tell what time it is during the night, or on dark winter mornings, without getting out of bed and lighting a match. Such a light as this would be an especially appropriate gift for an elderly person who is wakeful at night.

A clock flash-light is not difficult for a handy boy to make, and when the battery is neatly encased as in Fig. 221, with the small electric lamp mounted upon top, the case makes a very attractive base on which to stand a bedroom clock.

The battery-case may be of oak, pine, whitewood, or any other easily worked wood; but if you wish to finish the wood with a stain, oak will look best on account of its decided grain. The case shown in Fig. 221 was finished with Mission-oak wood stain and then waxed.

The sides, ends and bottom of the case should be made of 3/8-inch wood, the base strips of 1/4-inch wood, and the top of a piece 3/4 inch thick. Figure 223 shows the dimensions for all of these pieces; also how the ends of the side, end, and base pieces are mitered, and how the base is put together. A piece of wall base-board having a projecting piece cut upon its lower portion was used in the construction of the battery-case shown in the photograph (Fig. 221), and if you can get a piece of similar form it will save nailing on the additional base strips. Coat the edges of the bottom, end, and side pieces with glue, and nail them together with finishing-nails. Then fasten on the base strips, if there is no projection on the side and end pieces. The top is screwed in place, so it may be removed to gain

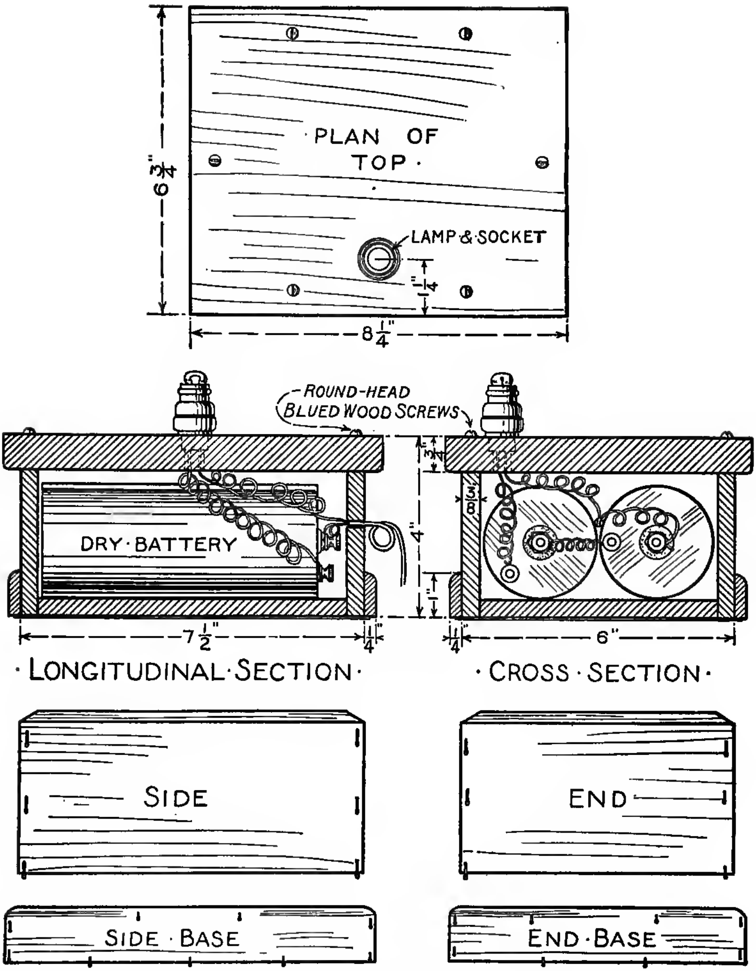


Fig. 223. — Details of the Clock Flash-Light Shown in Fig. 221.

access to the battery and wire connections. Use round-head blued wood screws 1¼ inches long, and space them as shown in the plan of the top (Fig. 223). Drill screw-holes of a trifle larger diameter than the screws, through the top piece, and holes of a trifle smaller diameter than the screws, in the top edges of the side and end pieces, so the screws will drive into place readily.

When you have finished the woodwork of the battery-

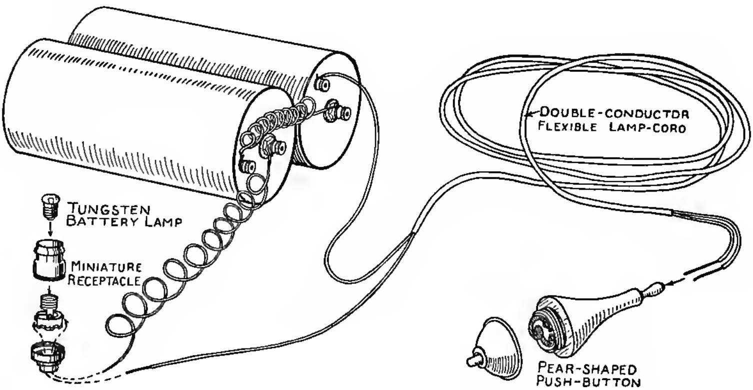


FIG. 224. — Battery, Lamp, Push-Button, Cord, and Connections of Clock Flash-Light.

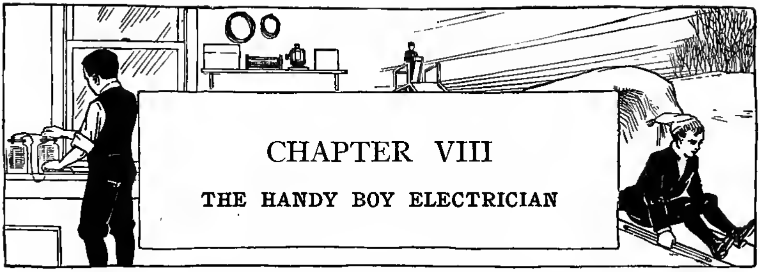
case, cut a piece of felt to fit the bottom and glue it in place, so the bottom will not scratch whatever it is stood upon.

The Light Outfit. Two *dry-battery cells* will cost 50 cents, 9 feet of *silk-covered double-conductor lamp-cord*, which will ordinarily be long enough to reach from the dresser or side-table over to the bed, will cost about 20 cents, *a pear-*

shaped push-button will cost 10 cents, a *miniature lamp receptacle* will cost 10 cents, and a *tungsten battery-lamp* will cost 30 cents, making the total expenditure for the lighting outfit about 1 dollar and 20 cents. The voltage of the lamp and battery should be taken into consideration when purchasing them, and, if the lamp is made for very small voltage, one battery cell only should be used.

Bore a hole through the top of the battery-case of the size of the lower portion of the miniature lamp receptacle (see *Plan of Top*, Fig. 223), and bore a hole in the center of one end of the case just large enough for the lamp-cord to pull through.

Figure 224, and the *Longitudinal* and *Cross Sections* in Fig. 223, show the proper wiring of the battery cells, push-button, and battery-lamp. The battery cells are connected in *series* (see Connecting Battery Cells, page 135). Run a wire from the cells to the lamp receptacle, another from the cells to the push-button, and connect the second wire from the push-button to the lamp receptacle. The double cord leading to the push-button extends through the hole bored in the end of the battery-case.



CHAPTER VIII

THE HANDY BOY ELECTRICIAN

THE handy boy's interest in electricity is but a natural sequence to his viewing with his own eyes the many and varied operations performed with this mysterious energy — running machinery, fusing together metals, furnishing artificial light, heating, and cooking. It is a Jack-of-all-trades which cannot help but fascinate a boy with a practical turn of mind, and the fact that he can obtain results with it himself, in his own home workshop, makes it appeal doubly strong to him.

The study of electricity is still in its infancy. Achievements thus far obtained, though marvelous as they have been, are as nothing compared to what the future promises to bring forth, and the responsibility of advancing electrical knowledge and demonstrating more of its possibilities is going to rest upon the shoulders of you handy boys of to-day.

Spare time experimental work in electricity is excellent preparation for a thorough study of it later, besides being a pastime which cannot be surpassed for supplying fun.

Several volumes would not exhaust the possibilities for electrical apparatus which could be devised for you boys to make — indeed, a volume might be devoted to the

subject of home-made *wireless telegraph outfits*[1] alone; therefore, it is quite impossible to include in this chapter more than some elementary work. But the ideas which I am presenting are very practical for the beginner, and will be found especially interesting by all handy boys because of their leading up to electrical toy making.

There are four means by which electricity may be produced — chemical, frictional, dynamic (by induction), and thermal. We shall confine our attention to generating it by chemical means through the use of batteries, as that is the simplest way for the beginner to produce it. Then we shall make some apparatus which batteries will supply current enough to operate.

There are a great many varieties of batteries, and every handy boy should familiarize himself with the properties of

The Common Forms of Batteries. They may be divided into two general classes — those made for *open-circuit* work, such as electric-bell circuits and telephone circuits, where the current is not drawn upon very long at a time; and those made for *closed-circuit* work, such as for operating toy motors, etc., where there is more or less of a steady drain upon the current.

Figures 225 to 228 show photographs of four types of batteries. A single battery is in reality a *cell*, and the term battery should be applied only to a group of two or more cells electrically connected; though, when used singly, a cell is often spoken of as a battery.

[1] For making and erecting the apparatus for a small, practical *Wireless Telegraph Outfit*, see Chapter XIV of "Handicraft for Handy Boys."

The Dry-Battery Cell (Fig. 225) is the most convenient form of open-circuit battery to use, because it contains no liquids to spill, and can therefore be placed in any position. A dry cell consists of a zinc case, which is one *pole*, a center stick of carbon, which is the other pole, and a gelatin-like chemical compound filler. Dry cells cost 25 and 30 cents apiece. Cells that have become too weak to *spark* an automobile are often plenty strong for experimental work, when grouped together, and these can generally be obtained for the asking, at a garage.

The Sal-Ammoniac Battery Cell (Fig. 226) is the commonest form of wet-battery cell. It is of the open-circuit type. A sal-ammoniac cell consists of a glass jar, from the top of which is suspended a *carbon* cylinder and a *zinc* pencil. The latter drops through a porcelain *bushing* that fits in a hole in the carbon cylinder. The battery fluid, or *electrolyte* as it is called, is a saturated solution of *ammonium chloride* (known as sal-ammoniac) in water. Enough of this solution should be poured into the jar to come within 1 inch of the top, when the carbon and zinc *elements* are lowered into it. The top of the carbon cylinder is coated with paraffine, to keep the salts from creeping out over the edge of the jar. The fluid of this cell must be renewed occasionally, the zinc element must be replaced when eaten away by the action of the solution, and the carbon element will require boiling in hot water once in a great while, to remove the salts which will deposit upon it. A complete sal-ammoniac cell, with sal-ammoniac enough for

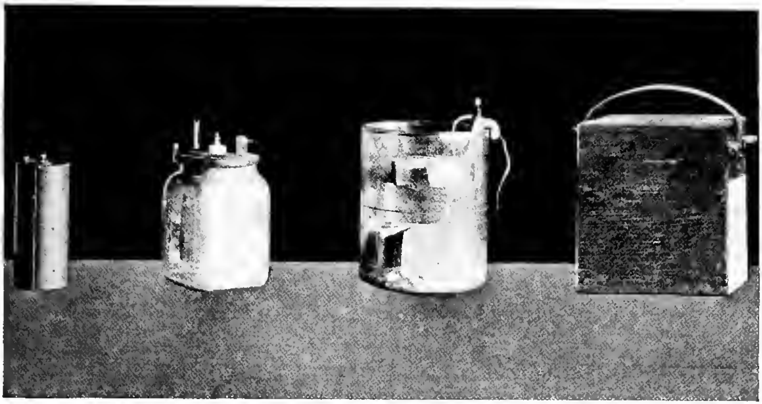


FIG. 225.
DRY-BATTERY CELL.

FIG. 226.
SAL-AMMONIAC BATTERY CELL.

FIG. 227.
GRAVITY BATTERY CELL.

FIG. 228.
STORAGE BATTERY.

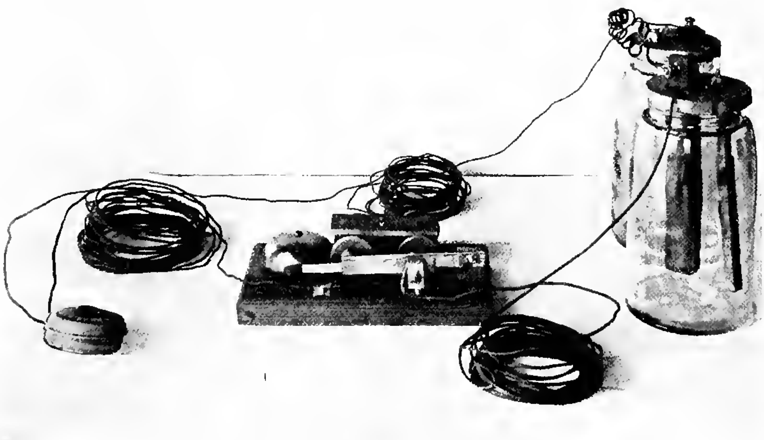


FIG. 229.—A HOME-MADE ELECTRIC-BELL, BATTERY AND PUSH-BUTTON.

one charge, costs about 35 cents. Several forms of sal-ammoniac cells that are easy to make are described further on in the chapter.

The Bi-Chromate Battery Cell is sold in various forms; but a sal-ammoniac jar and its carbon and zinc elements may be used, with the substitution of the bi-chromate solution for the sal-ammoniac. The preparation of this solution is described on page 132. This makes a much stronger cell than the sal-ammoniac cell, and it is the better form to use for operating small motors, where a continuous current is required; but, as the solution destroys the zinc element more quickly, and acts upon it even while the current is not being drawn upon, the zinc should be removed when the cell is not in use. The solution is also destructful to clothing and carpets, and on this account should be handled carefully, and only in the basement or workshop.

A Plunge Battery consists of one or more cells arranged in a framework provided with a drum and crank for raising the elements out of the battery fluid. By this arrangement, the elements are protected from the fluid while the battery is not in use. It is only necessary to remove the elements from the battery fluid when a bi-chromate or similar strong acting fluid is employed. Figure 239 shows a home-made plunge battery.

A Gravity Battery Cell (Fig. 227) has a *copper* element of several thin strips of copper, in place of the carbon used in the cells previously described, and the zinc element is

made in the form of a bird's foot, whence it derives the name of *crowfoot*. The copper element sets in the bottom of the jar, and the crowfoot hangs over the edge of the jar.

This is a two-solution cell. The heavier fluid, which is a saturated solution of *copper sulphate* (blue vitriol) in water, keeps to the lower portion of the jar, and the lighter fluid, a saturated solution of *zinc sulphate* in water, keeps to the top. There should be a sharp line of separation between the two solutions, and this may be obtained quickly by *short-circuiting* the two poles — that is, connect the two elements with a wire and allow the current formed to pass through the solutions. The copper sulphate is the *exciting* fluid, and the zinc sulphate is the *de-polarizer* — that is, it destroys the bubbles of hydrogen gas which form around the copper element and slow up the flow of current. There is more or less polarization in every battery cell. That is why dry cells and sal-ammoniac cells will not do for closed-circuit work. They must be given a rest now and then, to allow time for the destruction of the hydrogen bubbles. The gravity cell has a minimum amount of polarization. A cell costs between 60 and 75 cents.

The Storage Battery (Fig. 228) does not generate electrical current, but merely discharges electrical energy which it has accumulated through the passing of an electric current into it. There are various forms of storage batteries, but the common type consists of a series of sheet-lead plates placed in a water-tight compartment that contains a solution of sulphuric-acid and water. No action takes

place in the cells until the current passes into them; then a chemical change occurs, and the battery becomes charged. When the battery is drawn upon, the cells give up this stored energy, and gradually return to their original state; then they must be recharged.

Storage batteries are expensive, those used in automobiles costing fifteen dollars and over. Sometimes you can buy an old storage battery cheaply at a garage, which will be plenty good enough for experimental work. A battery of one of the forms of cells previously described, or one of the following home-made cells, will serve most of the purposes of a boy experimenter, however.

A Home-Made Sal-Ammoniac Battery Cell may be prepared as shown in Fig. 230. A glass tumbler will do for a jar, an old battery zinc pencil with several inches of the

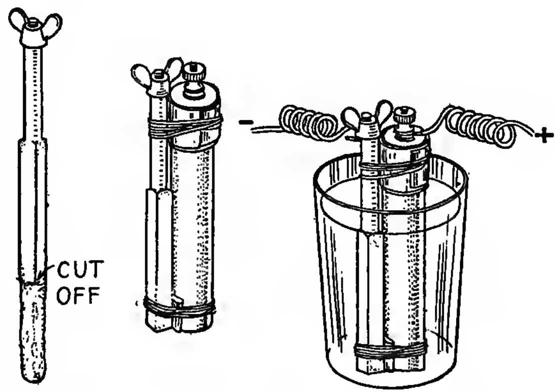


FIG. 231. FIG. 232. FIG. 230.

FIG. 230.—A Home-Made Sal-Ammoniac Battery Cell.
FIGS. 231 and 232.—Details of Zinc and Carbon Elements.

eaten end cut off will do for the zinc element (Fig. 231), and the carbon from a worn-out dry-battery, cut to a corresponding length, will do for the carbon element. Fasten together the zinc and carbon with rubber-bands, as shown in Fig. 232, after wrapping a piece of bicycle-tape around the upper end of the carbon, and inserting a small wad of it between the lower ends of the carbon and zinc, to keep them from touching one another.

Make a saturated solution of sal-ammoniac in water; that is, put as much sal-ammoniac into a tumbler of water as the water will dissolve. The crystals will dissolve more readily if warm water is used.

This cell will not be strong enough for more than simple experimental work; but two or more cells may be connected in *series* (Fig. 233) when more *voltage* is needed. See *Methods of Connecting Battery Cells*, page 135.

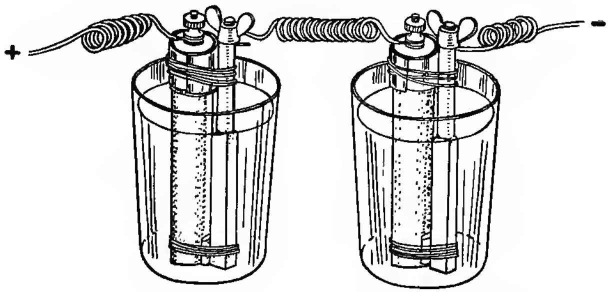
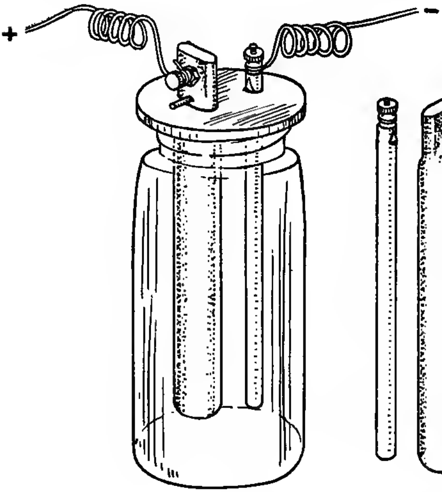
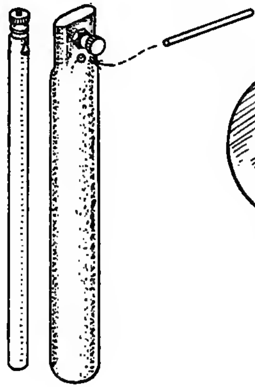


FIG. 233. — Two Sal-Ammoniac Cells Connected in Series.

A quart-size Mason fruit-jar, a large tobacco jar, or a wide-necked pickle bottle, can be used for

A Larger Sal-Ammoniac Cell. Use a full-length zinc pencil and an old dry-battery carbon for the elements (Figs. 234 and 235). Cut a round or square block of wood for a top to the jar (Fig. 236), and make holes in it for the ends





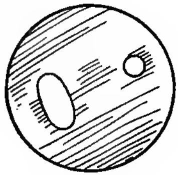


FIG. 236.

FIG. 235. FIG. 234.

FIGS. 234–236. — Details of Fruit-Jar Battery Cell.

of the zinc and carbon to stick through. Dip this top in melted paraffine, and brush the edges of the jar with paraffine, also. This will prevent the fluid salts from creeping out.

If you use a zinc similar to the one shown in Fig. 234, the little *lugs* upon its sides will be sufficient to support it. To support the carbon, drill a hole through it just below the connection thumb-nut, with the point of a nail, and

slip a match through the hole (Fig. 234). As carbon is very brittle, the hole must be drilled very carefully.

Another Form of Carbon Element is shown in Fig. 238. Pick up some arc-lamp carbon ends from around the street-corner lamp-poles, and remove the copper coating from them with a file or sandpaper. Then bind five of the pieces around a center piece, as shown in Fig. 238, allowing the upper end of the center piece to project about 1½ inches above the others. With the point of a nail drill a hole through the center carbon, just below the top, through which to stick a match for support (Fig. 237). The connecting wire is also run through this hole.

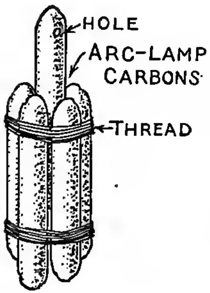


FIG. 238.

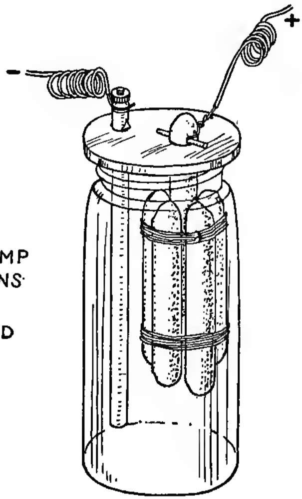


FIG. 237.

FIG. 237. — Another Fruit-Jar Battery.
FIG. 238. — Arc-Lamp Carbon Element.

A Home-Made Bi-Chromate Battery Cell has a zinc and a carbon element similar to those of the sal-ammoniac cell, and a tumbler or Mason fruit-jar may be used to hold the battery fluid.

The Bi-Chromate Battery Fluid is made up of bi-chromate

of potash, sulphuric acid, and water, in the following proportions:

4 ounces of bi-chromate of potash
4 ounces of sulphuric acid
1 quart of water

In making up this solution, first add the acid to the water, — *never add the water to the acid,* — and then, when the solution is nearly cool, add the bi-chromate of potash. Pour the acid into the water slowly, because the combination of the two creates a great deal of heat, and if the heat forms too quickly your glass bottle is likely to split. Label the bottle in which you put this solution POISON.

As the bi-chromate solution attacks the zinc element of a cell even when the current is not being drawn upon, the zinc should be removed when the cell is not in use.

Amalgamating a Zinc Pencil. To reduce the eating away of a zinc pencil used in a bi-chromate solution, the zinc should be amalgamated by rubbing a thin coat of mercury over its surface. Dip the zinc into the solution, first, then with a rag dipped in the solution rub the mercury on to it.

A Home-Made Plunge Battery (Fig. 239). The plunge battery illustrated contains two bi-chromate cells, with an arrangement by which the elements of the cells can be raised out of, and lowered into, the solution.

A grocery box can be cut down to a convenient size for the rack. Nail the uprights *A* (Fig. 239) to the ends of the rack, to support the winding drum *C*, and make them of the right length so *C* will be the length of the carbons above

the battery jars. Screw screw-eyes into the tops of uprights *A* for drum *C* to turn in (*B*, Fig. 239), and drive the

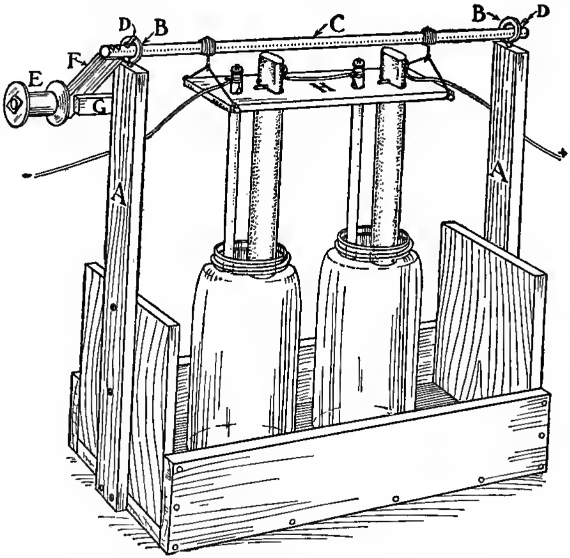


FIG. 239. — A Home-Made Plunge Battery.

wooden pins *D* (Fig. 240) through drum *C*; near the ends, to prevent the drum from slipping through the screw-eyes.

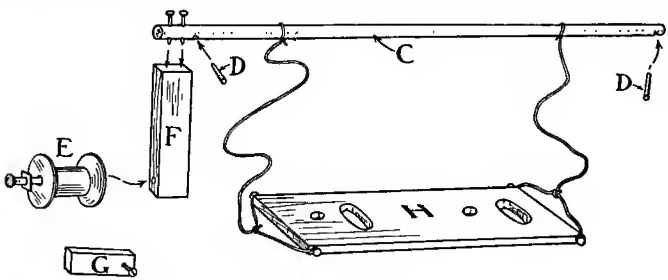


FIG. 240. — Detail of Drum and Crank for Lifting Battery Elements.

A spool forms the crank handle *E* (Fig. 239). This is pivoted with a nail to the crank *F*, and the end of the drum is nailed to the end of the crank (Fig. 240). The button *G* is screwed to one edge of the upright *A* at the crank end, and, when turned to the position shown in Fig. 239, checks the crank. The board *H* supports the battery elements, and the raising cord is attached to nails driven into its edges and to drum *C*.

Methods of Connecting Battery Cells. Battery cells may be connected in *series*, *parallel* (also known as *multiple*), or by a combination of both ways, known as *series-parallel*. Figure 241 shows these connections. You will notice that in the *series* connection, the carbon of one cell is connected to the zinc of the cell next to it, that in the *parallel* connection all of the carbons are connected to one wire, and all of the zincs to the other wire, and that in the *series-parallel* connection one-half of the number of cells are connected in series in each of two sets, and then the end cells are connected in parallel.

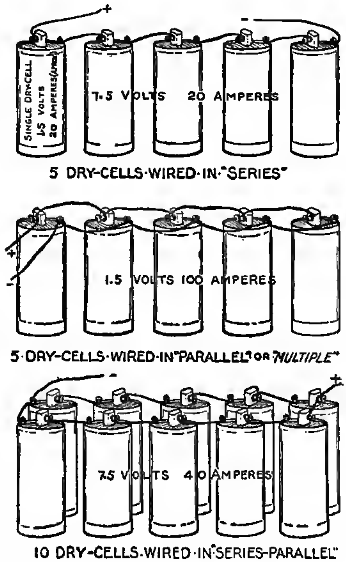


FIG. 241. — The Three Methods of Wiring Battery Cells.

Five cells are shown in the illustrations, but, of course, two, three, or four are connected in the same way.

One of these three methods is always used, according to what *voltage* and *amperage* is required. Figure 241 shows the number of volts and amperes secured with five dry-cells, and two combined sets of five. If the cells are connected in *series*, the set will have the combined voltage of all the cells (7.5 volts), but the current in amperes will equal only that of a single cell (20 amperes, if all cells are alike); while, if the cells are connected in *parallel*, the voltage will equal that of only one cell (1.5 volts), but the current strength, or amperage, will equal the combined amperage of all the cells (100 amperes). Then coming to the *series-parallel* method, each set of five cells will have a combined voltage of the five cells (7.5 volts), and the amperage of one cell (20 amperes), but when the two sets are connected parallel, the amperage will be doubled (40 amperes).

These are the rated capacities of dry-cells. Twenty amperes, however, would be an excessive amount of current to draw from a single cell, and would quickly exhaust it. Four or 5 amperes is about the maximum amount which should be used. In connecting cells in series-parallel, there should be an equal number of cells in each set; otherwise, one set would be exhausted by the other.

There are many

Electrical Measurements to be learned; but I am going to explain only the *volt*, the *ampere*, and the *ohm*, which are the three most important ones for a boy to understand in connection with his experimental work.

The Volt is the unit of electrical pressure. Electricity will not flow along a wire unless there is a pressure behind it, any more than water in a level ditch will flow unless there is a pressure back of it. This pressure which makes electricity flow is known as *voltage*, and the greater the pressure, the greater the voltage will be.

The Ampere is the unit of current strength, and may be likened to the volume of water flowing through a ditch. The greater the volume that flows along a wire, the greater the amperage will be.

The Ohm is the unit of resistance. Any conductor of electricity, such as wire, sheet-metal, carbon-rod, etc., offers resistance to the flow of electricity in the same way that the sides of a ditch offer resistance to water flowing through that ditch. If the sides of the ditch are made of cement, the water will flow more readily than if they were of jagged rocks; and in the same way some substances used for electrical conductors have low resistance to electrical currents, while others have high resistance. For example, silver has the least resistance, copper comes next, iron has considerable, and German-silver has such an excessive amount that it is used in the construction of resistance coils, and other apparatus where great resistance is necessary.

Binding-Posts. Every piece of electrical apparatus requires binding-posts as a provision for making electrical connections. These posts can be purchased at any electrical supply house, but for home-made apparatus a boy

can make his own binding-posts. Figures 242 to 245 show several simple forms. The one in Fig. 242 consists of a

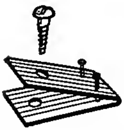


Fig. 242.

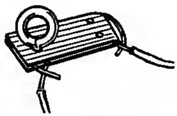


Fig. 243.

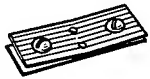


Fig. 244.

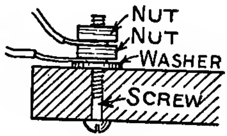


Fig. 245.

Figs. 242–245. — Home-Made Binding-Posts.

short strip of tin, brass, or copper, bent in half, with a hole punched through it near each end for a small screw. The folded end of this metal plate should be nailed with brads to the base of your apparatus. Use a small round-head screw for the binding-screw.

Figure 243 shows a variation of this form of binding-post, with a screw-eye substituted for the round-head binding-screw. This illustration also shows how the stationary wire is connected to the folded end of the metal plate, and how the screw-eye is screwed down to hold the other wire between the ends of the plate. The advantage of the screw-eye is that it can be turned by hand, while an ordinary screw requires the use of a screw-driver.

The binding-post in Fig. 244 requires two short strips of metal, punched near each end for screws, and it is fastened at its center to an apparatus, with brads. Screw-eyes may be used in place of the screws shown, for binding-screws.

The binding-post in Fig. 245 consists of a short machine-

screw, a washer, and two nuts. Drill a hole of the diameter of the machine-screw through the base of the apparatus for which the binding-post is required, and slip the screw through so the head will come upon the under side of the base; then slip the washer over the upper end, and screw two nuts on to it. One of the apparatus wires should be connected between the washer and the lower nut, and the wire from the battery, motor, or other apparatus, to be connected to it, should be fastened between the two nuts.

A Home-Made Switch. A switch is convenient for opening and closing an electrical circuit, as it saves disconnecting one of the wires. Figure 246 shows a simple home-made switch, and Fig. 247 shows details of its various parts.

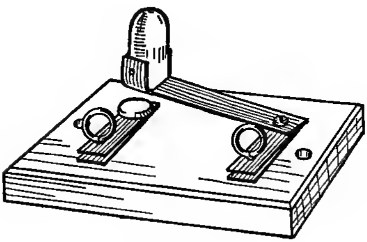


FIG. 246.

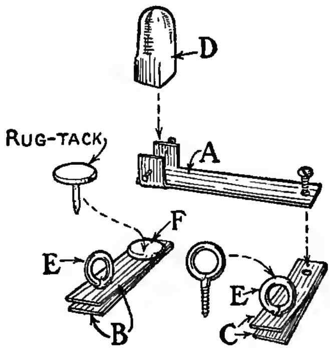


FIG. 247.

FIGS. 246 and 247. — A Home-Made Switch.

Strips *A*, *B*, and *C* should be made of tin or brass. The binding-post plates *B* and *C* are similar to one of the binding-posts previously described. Tack the tips on strip *A*

to the sides of a wooden knob cut similar to *D*, and drive a screw through the other end of *A*, through plate *C*, and into the base block. Fasten plate B parallel to *C*, and drive the rug-tack *F* through it for a contact point. The electrical connections are made at the binding-posts *E;* then, when lever *A* is swung over so the knob end strikes the contact point, the circuit is closed.

A Double-Pole Knife-Switch is easy to make, and as it has two sets of binding-posts, it can be used to open or close two circuits with one throw of the switch lever (Figs. 248 and 249). Make the bars *B* out of strips of tin doubled

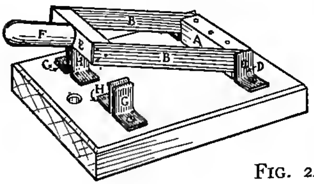


FIG. 248.

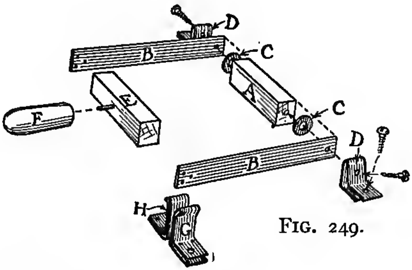


FIG. 249.

FIGS. 248 and 249. — A Double-Pole Knife-Switch.

in half, cut the blocks *A* and *E* of equal size, and cut the handle *F* from the end of a broom-handle. Fasten *F* to the center of block *E*, with a nail, and tack one end of strips *B* to the ends of block *E*. The posts *D*, *G*, and *H* are made of tin, and should be bent into the forms shown in the detail drawing. Punch two holes through posts *D*, and one hole through *G*, for screws. The bent out ends of posts *D* and *G* form the binding-posts.

Screw the ends of bars *B* to the ends of block *A*, passing the screws through the posts *D*, through bars *B*, through the metal washers *C*, and then into block *A*. The screws should be driven in just tight enough so the bars will turn easily on them. Tack the ends of posts *G* directly in line with posts *D*, and at the same distances apart that posts *D* have been fastened; then place posts *H* back to back with posts *G*, allowing just enough space between them for bars *B* to slide down between and make contact with them. The tops of posts *G* and *H* are bent away from each other, slightly, to guide the bars into the contact spaces between the posts.

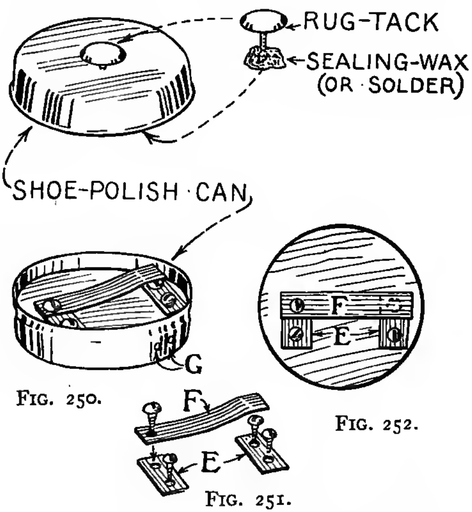


FIG. 250. FIG. 251. FIG. 252.

FIGS. 250–252. — A Home-Made Push-Button.

A Home-Made Push-Button. A splendid push-button can be made with a shoe-polish can (Fig. 250). This is shown in connection with the home-made electric-bell outfit in Fig. 229. Cut a block ¼ inch thick and of the inside diameter of the can, and screw the two binding-post plates *E*, and the contact spring *F*, to this block with small

screws. One end of the spring strip *F* is screwed down on top of one of the binding-post plates, and the free end comes in contact with a screw in the other binding-post plate. The other screw shown in each plate is a binding-post screw. Punch two holes through the side of the can to run the connecting wires through to connect to the binding-posts.

Get a brass rug-tack for the button. File off its end short, and drop enough sealing-wax or solder on the remaining end to keep the tack from slipping out of the hole in the cover. The free end of the spring strip must be so bent that when the rug-tack button is pushed the sealing-wax or solder will press the strip down into contact with the screw-head of the binding-post plate.

An Electro-Magnet. The difference between an electro-magnet and the toy variety of horseshoe-magnet with which every boy is familiar, is that the electro-magnet retains its magnetism only so long as an electric current is passing around it, while the steel magnet retains its magnetic influence permanently, after once becoming magnetized, unless it happens to be de-magnetized by being subjected to a strong heat, or in some other way.

The electro-magnet is used in the construction of so many pieces of electrical apparatus, that it is important for a boy to know how to make one. Figure 253 shows a simple electro-magnet, and Figs. 254 and 255 show the details for making it.

An electro-magnet consists of a center *core* of soft iron, wrapped with a coil of insulated wire. When an electric

current passes over a wire, a *magnetic field* is formed around the wire; and when several turns of insulated wire are wrapped about a soft iron core, the magnetic fields of all the turns of the coil, or *helix*, combine, forming a very strong magnetic field which strongly magnetizes the iron core. As I have said before, this magnet loses its magnetic influence the instant the current ceases to pass through the surrounding coil of wire.

You will need a machine-bolt or carriage-bolt 2½ or 3 inches long, and ¼ inch in diameter, for the core of the

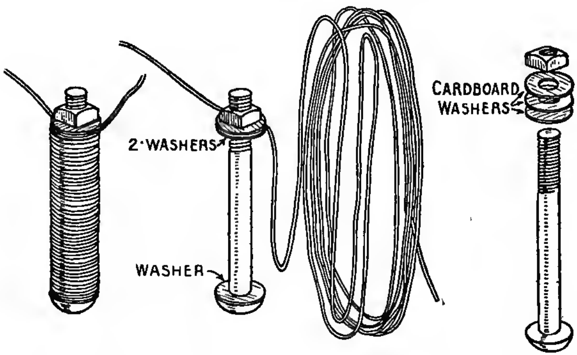


FIG. 253. FIG. 255. FIG. 254.

FIGS. 253–255. — An Electro-Magnet.

magnet, some insulated electric-bell wire for the coil, and a piece of heavy cardboard. Cut three washers of a trifle larger diameter than the bolt-head, out of the piece of cardboard (Fig. 254), and slip these over the bolt as shown in Fig. 255 — one at the bolt-head end, the other two at the nut end; then screw the nut on to the end of the bolt.

Before starting to wind the insulated wire upon the bolt, pierce two holes through the inner cardboard washer of the two at the nut end. Then stick the end of the wire through one of these holes, and pull a length of 4 or 5 inches of the wire out between the two washers. Starting at this end of the bolt, then, wind the wire around the bolt, keeping the turns even and each turn pressed close against the preceding turn. When the washer at the head end of the bolt has been reached, wind back to the starting point; then wind back to the washer at the head a second time, and again back to the starting point; and so on, until six or eight layers of wire have been wound in place. An even number of layers will bring the free end of the wire back to the double-washer end. Slip this end through the second hole in the inner washer, and bring it out between the two washers, as you did the first end. Then screw the bolt-nut tight against the washers, to hold the wire ends in place (Fig. 253). The outer cardboard washer will prevent the nut from chafing the insulation on the wire ends.

Now connect the ends of the coil to the binding-posts of a battery cell, and you will be surprised to find what a strong magnet the head of the bolt core has become. To use the magnet as a toy for lifting nails, screws, pocket-knives, and scissors, it is best to set in a small switch or push-button between the cell and one wire of the magnet coil, so things can be picked up or dropped by closing and opening the circuit. It is also more convenient to handle

the magnet, if the connecting wires are made long enough so the cell does not have to be carried about.

An Electric-Bell Outfit. The making of an electric-bell is simple and very interesting work, and with a home-made push-button such as that shown in Fig. 250, and two sal-ammoniac cells made in one of the ways described upon preceding pages, a boy can prepare a complete bell outfit. Figure 229 shows a photograph of just such a home-made outfit, and Fig. 256 shows a drawing of it.

The working principle of an electric bell is this: When the push-button is pressed, the current from the bell battery

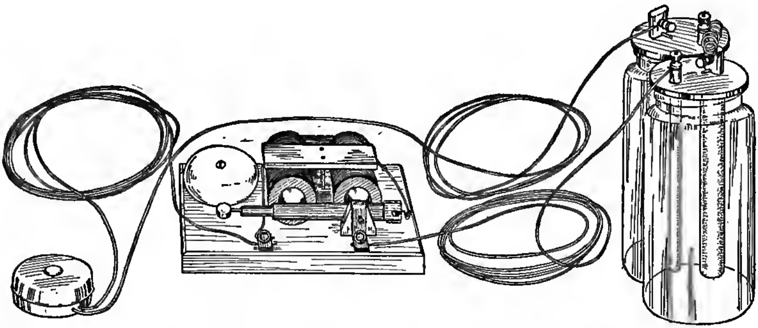


Fig. 256. — Detail of Home-Made Electric-Bell Outfit Shown in Fig. 229.

passes along the insulated wire and through the coils of wire of a *horseshoe electro-magnet*, which is a form of electro-magnet described later, and this magnet becomes magnetized and draws the bell hammer-arm, or *armature*, towards its *positive pole.* Then, the instant that the armature is pulled away from the little *contact screw* that presses against it, the electrical connection is broken, the horseshoe electro-

magnet loses its magnetic influence, and the armature springs back to its former position resting against the little contact screw. This closes the circuit again; then the current flows through the magnet coils, and the armature is drawn away from the contact screw as before. These movements repeat as long as the push-button is pressed. Of course the armature vibrates so rapidly that you cannot notice how the action takes place, except if you give the push-button a very light tap.

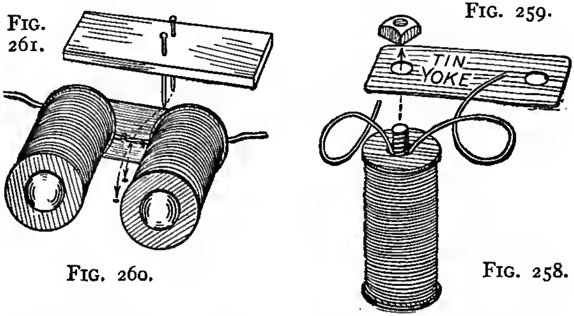
The Horseshoe Electro-Magnet is the first portion of the bell to make. This magnet has two poles, a positive and a negative pole, just like those of a toy magnet. It consists of two coils of wire wound around a U-shaped core of soft iron, and the two different poles are obtained by winding the wire in opposite directions so as to make the current flow around the coils in opposite directions.

Buy two ¼-inch or 5-16-inch carriage-bolts 2½ inches long for the iron cores — the two legs of the horseshoe, — four ½-inch iron washers (washers having ½-inch holes), and ½ lb. of ordinary insulated bell wire.

Slip two washers upon each bolt, and screw the nut on to the end, temporarily. One washer forms each end of the coils. Slip a length of 4 or 5 inches of the end of the insulated wire through the hole of the washer at the nut end of the bolt; then carefully wind the wire around the bolt from that washer as far as the washer at the bolt-head end. Wind back to the starting point, then to the bolt-head end again, and so on, back and forth until the height of the

washers has been reached. Wind an even number of layers on the bolts, so the upper end of the coil can be brought out through the hole in the washer at the nut end of the bolt, where you started. Figure 258 shows one core completely wound. Be sure to wind the wire on the two cores in opposite directions.

If you now connect both ends of each coil to a battery



FIGS. 258–261. — Details of Horseshoe [Electro-] Magnet for Electric-Bell.

cell, you will find that each core is magnetized, and that you have two electro-magnets.

These two electro-magnets are connected at one end with a metal *yoke*, to form the horseshoe electro-magnet. Make the yoke out of a strip of tin 1 inch wide and 3 inches long, and with a nail punch holes through it 2 inches on centers, large enough for the magnet bolt ends to stick through (Fig. 259). Remove the nuts, and slip the yoke over the bolt ends, then screw the nuts in place again tight against the ends of the magnet coil ends (Fig. 260).

Now connect together the lower ends of the two coils, and the horseshoe electro-magnet will be complete. To test it, connect the upper end of each coil to a cell. If the windings of the two coils have been put on in opposite directions, the current will pass through one coil *clockwise*, and through the other *counter-clockwise*, and one magnet end will be found to attract (the *positive pole*), and the other end to repel (the *negative pole*).

Mount the horseshoe magnet upon a base block 4 inches wide and 7½ inches long, in the position shown in Fig. 257, using a wooden cleat (Fig. 261) with which to hold it in position.

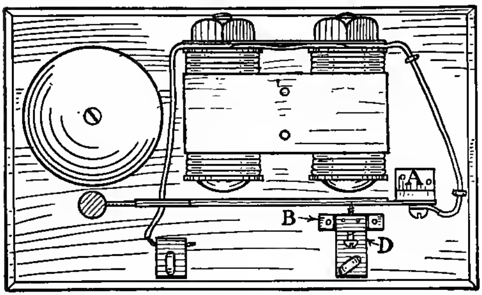


FIG. 257. — Plan of Electric-Bell.

Details of the armature are shown in Figs. 262 and 263. It is made of tin cut from a tomato can, and the hammer from a broken alarm-clock. Cut the piece of tin 5 inches long and 1½ inches wide, over all, with a 1-inch tab on the hammer end, and a ¾-inch tab on the opposite end, as shown. Fold the sides of the piece over on to the middle portion (Fig. 263); then fold the sides of the tab on the hammer end over the stem of the hammer, and pound it down until it holds the wire securely. Punch a hole through the opposite end of the armature large enough

for a small screw, and screw it at this point to a small block of wood cut similar to *A* (Fig. 263). Fasten block *A* to the base in the position shown in Fig. 257, with the armature exactly parallel to the magnet heads and about 3-16 inch away from them.

Figure 264 shows the details of the contact screw, with which is combined one binding-post. Cut block *B* out of

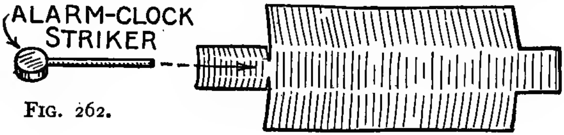


FIG. 262.

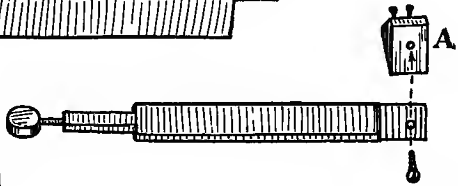


FIG. 263.

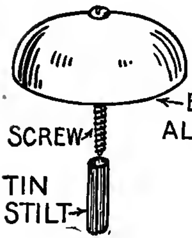


FIG. 266.

FIG. 265.

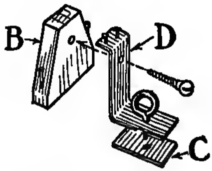


FIG. 264.

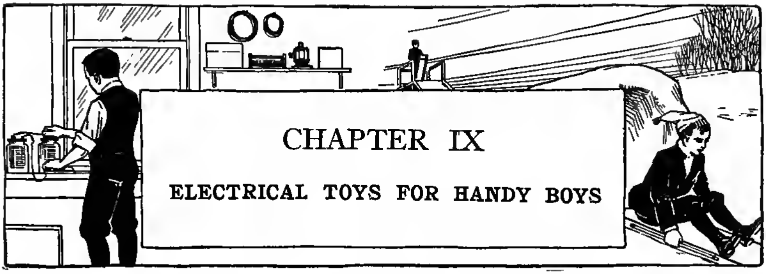
FIGS. 262–266. — Details of Electric-Bell.

hard wood; tack the strip of tin *D* to its top and face, and nail the block with brads to the base block, near the pivoted end of the armature (Fig. 257). Tack the piece of tin *C* to the base block, under the end of *D*, and punch a hole through both *C* and *D* for the screw-eye binding-post to run through.

Fold a small piece of tin in half for the second binding-

post plate (Fig. 265). Tack the lower portion to the base, and pierce a hole through both portions for a screw-eye binding-post. This binding-post may be fastened almost any place on the base. Connect one of the upper coil ends to this binding-post, and connect the other coil end to the screw which holds the armature to block *A* (Fig. 257). The wires leading from the battery connect to the two binding-posts.

Mount the bell from a broken alarm-clock upon a tin stilt made like that shown in Fig. 266, using a long enough screw to extend well into the base block. Place the bell in such a position that the armature cannot be drawn closer than 1-16 inch to the bolt-head; because just enough magnetism will remain in the bolt-head, after the electrical contact has been broken, to hold the armature fast to it, if the armature strikes the head. You will have to adjust the little contact screw, and possibly shift the position of the magnet, after mounting, to such positions as will make the armature vibrate the steadiest and strongest.



CHAPTER IX

ELECTRICAL TOYS FOR HANDY BOYS

An electro-magnet can be used in the construction of a number of home-made electrical toys, and one of the most interesting of these is

An Electro-Magnet Derrick like the one shown in Fig. 267. (See also photograph in *Frontispiece.*) Lots of fun

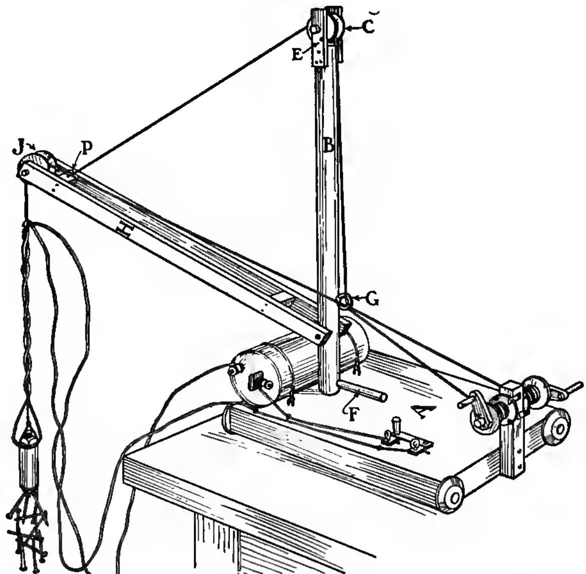


Fig. 267. — An Electro-Magnet Derrick. (See Frontispiece.)

can be had with this little derrick, hoisting nails and other small pieces of hardware from the floor to a table top, and as the *boom* or arm of the derrick can be swung from side to side, and raised and lowered, loads can be swung from place to place in just the same way as with large derricks. The derrick may be used for loading and unloading toy wagons, carts and trains of cars, provided, of course, you use iron or steel of some sort for your loads. It is easy enough to get nails, brads, tacks, and odd pieces of hardware for the purpose. The *Frontispiece* photograph shows the electro-magnet derrick lifting 284 3/8-inch brads, and by using very small tacks it is of course possible to lift a much larger number.

The Electro-Magnet is shown in Fig. 268, and Figs. 253 to 255, page 143, show details for making it. One end of the magnet coil should be connected to a dry-cell, and the other to a switch; and another wire should connect the switch with the dry-cell. Make the switch like the one shown in Fig. 246 or that in Fig. 248. Before making these connections, however, build

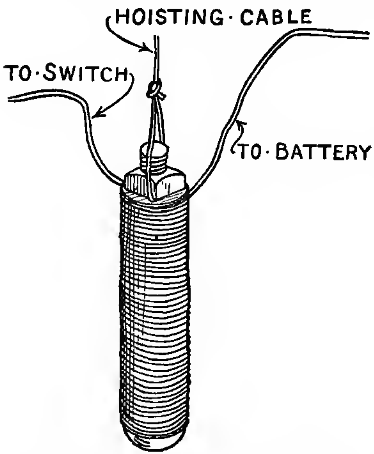


FIG. 268. — The Electro-Magnet. (For details see Figs. 253–255.)

The Derrick. Cut the derrick *base* about 8 inches wide and 10 inches long

(*A*, Fig. 267). The *mast* (*B*) is a piece of broom-handle or curtain-pole 16 inches long, and fits loosely in a hole bored in the base. Figure 269 shows a detail of the mast. The *pulley* upon its upper end (*C*) is made of two spool-ends nailed together (Fig. 270), and it turns upon the axle *D*, which slips through holes in the *plates* *E* nailed to the end of the mast. The *lever* *F* sticks in a hole in the mast, close to the platform. This is used to swing the *boom* from side to side. Screw-eye *G* is placed several inches above *F* to serve the purpose of a pulley to guide the hoisting cables.

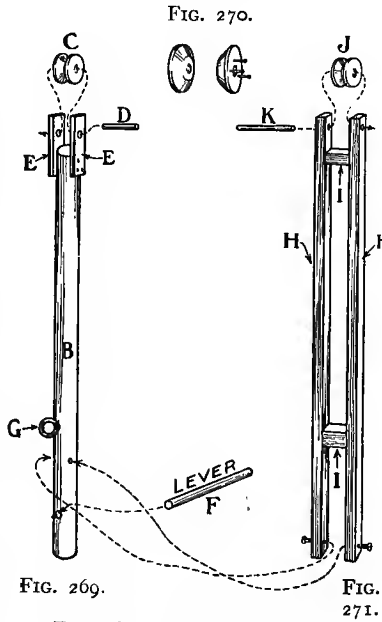


FIG. 269. — Detail of Mast.
FIG. 270. — Detail of Pulley.
FIG. 271. — Detail of Boom.

Figure 271 shows a detail of the *boom*. Cut the side sticks *H* 18 inches long, and fasten between them the *separators* *I*, which should be just long enough to allow clearance for the *spool pulley* *J*. The pulley is mounted on the axle *K*. Screw the lower ends of the boom to the mast, at a point 2½ inches above the base.

The Windlass for raising the derrick boom, and for

hoisting the loads, is shown in detail in Fig. 272. Bore a hole through upright *L* for the axle *M* to stick through, and cut axle *M* enough smaller than the spool drums *N* so they will turn easily. Fasten a crank and handle to one end of each spool, and drive a brad through each end of the axle to prevent the drums from sliding off. Cut four notches in the inner flange of each spool, as shown, and pivot the catches *O* to the post *L*, in the positions indicated, so they may be thrown into the notches to lock the windlass (Fig. 267).

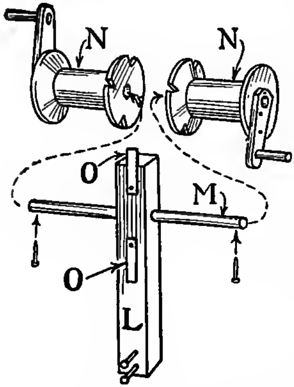


Fig. 272. — Detail of Derrick Windlass.

The Hoisting Cables should be made of strong cord. Fasten one end of the cable for raising the boom to a nail (*P*, Fig. 267), and run this cord up and over the mast pulley, then down through screw-eye *G* and over to one drum; tie it securely to the drum so it will not slip around. The other cable should be fastened between the nut and washer of the magnet, as shown in Fig. 268, run up and over the boom pulley *J*, then through screw-eye *G*, and tied to the second drum.

Figure 267 shows how the dry-cell may be strapped to the base board in front of the mast, and how the wires that connect the electro-magnet, switch, and cell should be twisted around the hoisting cable, part way, and the

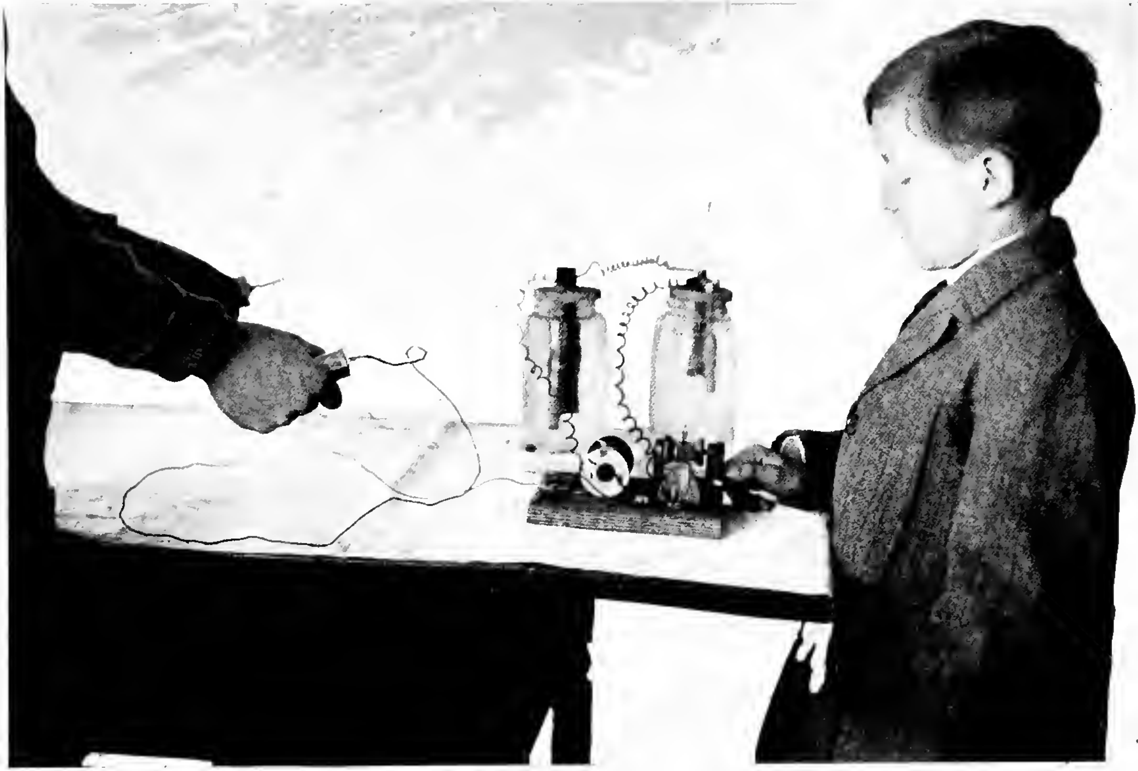


Fig. 273.—The Shock from this Toy will make your Friends dance.

remainder of their length allowed to hang. Be sure to cut the wires long enough to reach from a table-top down to the floor. Use flexible wire if you can get it.

By mounting the base upon spool wheels, your derrick can be moved along a table-top. Spool-ends may be used for the wheels, and can either be screwed to the edge of the base, or be fastened upon axles as the wheels of the *Electric Motor Truck* are fastened (Figs. 290 and 291).

How the Derrick Works. It is probably unnecessary to explain that a load is picked up by throwing over the switch lever to the contact point and closing the circuit, and that it is dropped by throwing off the switch lever and opening the circuit — which causes the electro-magnet to lose its magnetism.

A Toy Shocking Machine. The little shocking machine shown in Fig. 273 is a harmless toy with which you can have an endless amount of fun when entertaining friends. The shock it produces is not severe, but strong enough to make your friend's arm and wrist muscles twitch, and perhaps cause him to dance. Large shocking coils contract the muscles to such an extent that it is impossible to let go of the metal grips until the current has been shut off, but in our small shocking machine the handles can be dropped the instant the person holding them wishes to do so.

The shocking machine consists of an *induction-coil*, an *interrupter*, and a pair of *handles*, all of which are easy for

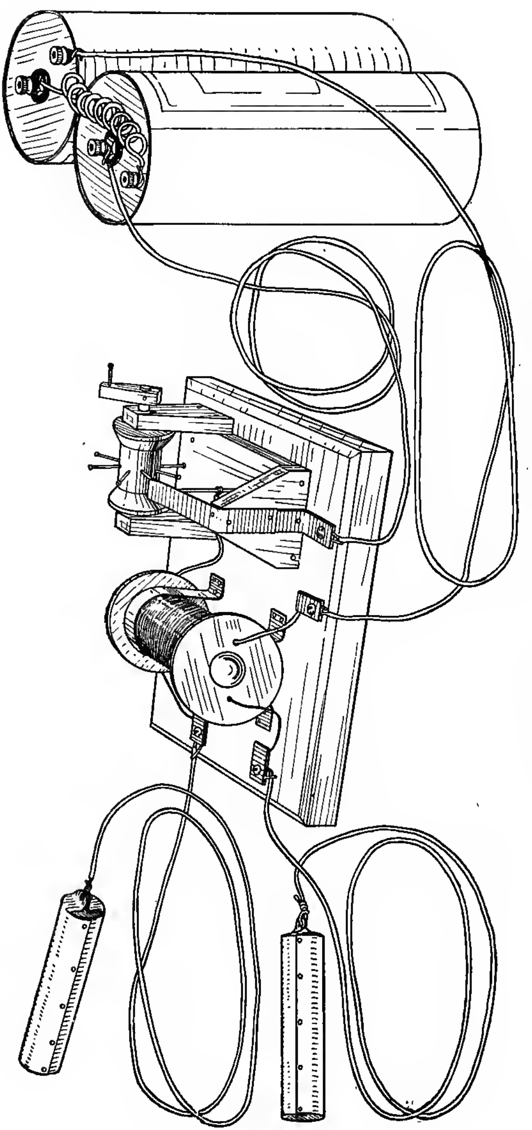


FIG. 274. — Detail of the Toy Shocking Machine Shown in Fig. 273.

a boy to make, and a *wet* or *dry battery* of one or two cells to furnish the current (Fig. 274).

The Induction-Coil is the first part to make. This is shown in detail in Figs. 275 to 277. The coil has windings

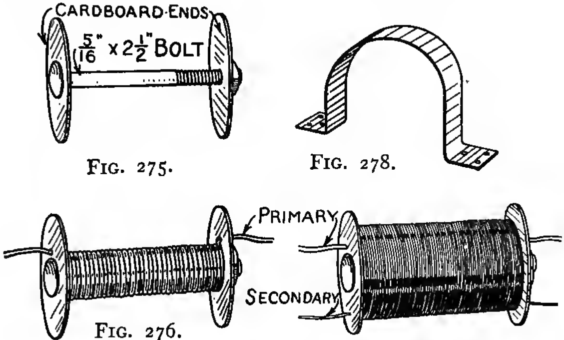


FIG. 275. FIG. 278.

FIG. 276. FIG. 277.

FIGS. 275–278. — Details of Induction-Coil.

of two sizes of wire upon an iron core. For the core buy a 5-16-inch carriage-bolt 2½ inches long, and for the wire coils get some No. 20- or 24-gauge electric-bell insulated copper wire, and some No. 30-gauge insulated magnet-wire. To keep the wire from slipping off the ends of the bolt core, cut two cardboard ends about 1½ inches in diameter. Slip one of these on to the bolt next to the head, and the other one next to the nut, as shown in Fig. 275.

Three layers of the coarse wire should be wound on first, for

The Primary-Coil. Pierce a hole through one card-board end, stick the wire through it, and allow about 5 inches to project upon the outside; then commence wind-

ing the wire upon the core, placing each turn close to the preceding turn. When the opposite end of the bolt has been reached, wind back to the starting point, then work back to the other end again. There will be in the neighborhood of 175 turns in the three layers. Cut off the wire so there will be a 5-inch projection, and stick the projecting end through a hole in the cardboard end. This completes the primary-coil (Fig. 276).

Before winding the small wire on top of the primary-coil, to form

The Secondary-Coil, wrap the primary-coil with a layer of bicycle tape, or glue several layers of paper around the coil. Then wind on the small wire as you did the coarser wire, being very careful to get it on evenly and smoothly. Wind eleven layers on the coil, and run the end of the eleventh layer out through the cardboard end (Fig. 277). There should be about 100 turns of this wire to the layer, or 1100 turns in all.

A crank arrangement can be rigged up to make the winding easier, but with patience, and by doing the work slowly, the wire can be wound almost as well by hand. It is difficult to keep track of each preceding turn, while winding, because of the fineness of the wire, and on this account it is a good scheme to coat each layer with bluing after it has been wound on, so that each turn of the following layer will show plainly against the stained layer beneath it. Figure 277 shows the completed induction-coil.

Cut a base block 5 inches wide and 7 inches long, bevel

the top edges to give it a trim appearance, and mount the induction-coil to one side of the center (Fig. 274), strapping it in place by means of two tin straps similar to that shown in Fig. 278, cut from a tin can.

The projecting ends of the primary-coil connect with the battery, while the two ends of the secondary-coil connect with the handles. Make three binding-post plates out of folded pieces of tin, similar to Fig. 242, 243, 244, or 245. Tack two of these to the end of the base and connect the secondary-coil wires to them (Fig. 274), and tack the third near one end of the induction-coil and connect one primary-coil wire to it (Fig. 274).

For the Handles take two pieces of broom-handle 3½ inches long, and cover each with a piece of tin (Fig. 284).

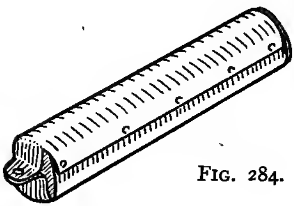


FIG. 284.

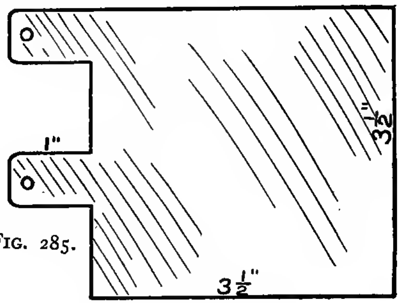


FIG. 285.

FIGS. 284 and 285. — Details of Shocking-Coil Handles.

The pattern for the tin covering (Fig. 285) shows how tabs are prepared on the ends and holes punched through them for connecting with the induction-coil. The connecting wires should be 5 or 6 feet long. Flexible wire is better than

bell-wire for these, because it is more easily handled in passing the handles around. Tack the tin covering to the pieces of broom-handle.

The purpose of the induction-coil is to raise the voltage of the battery. The flow of current must be an interrupted one, in order to shock, and therefore

An Interrupter must be inserted between the battery and one of the wires leading to the primary-coil of the induction-coil. Such an interrupter may be constructed similar to the vibrating armature of an electric-bell (see Figs. 257, 262, 263, and 264, pages 148 and 149); but the form shown in Fig. 274, and detailed in Figs. 279 to 283, is better suited to our toy shocking machine, and is easier to make and adjust.

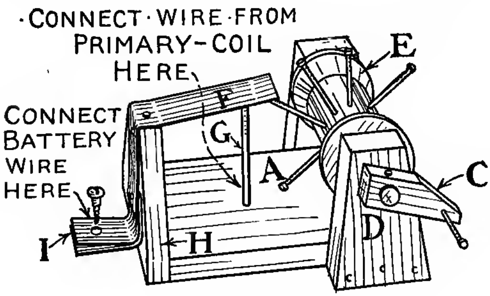


FIG. 279. — Interrupter for Shocking-Coil.

Cut the base block *A* 1½ inches wide and 2½ inches long. Make the shaft *B* 2¾ inches long and of a diameter equal to the hole in a thread spool; and prepare the crank *C* to fit on the end, and drive a brad into it for a handle. Fasten the crank to the shaft with glue, or by driving a small brad through the two. The shaft supports *D* should be prepared as shown in Fig. 281, 1¼ inches wide across the bottom, ⅝ inch wide at the top, and 1¾ inches high.

Bore a hole through each, a little below the top, and large enough so the shaft will turn easily, and fasten these supports with brads to the sides of base *A*. Drive eight brads into a thread spool, spacing them equidistant from one another, and mount this spool upon the shaft (*E*, Fig. 279), first slipping the shaft through one support, then through the spool, and then through the other support. Drive the spool brads a trifle into the shaft to hold the spool in position.

The projecting arm *F* (Fig. 279) is a strip of tin cut from a can, and must be long enough so each nail-head will strike

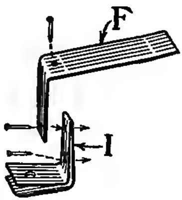


FIG. 283.

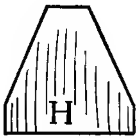


FIG. 282.

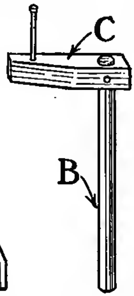


FIG. 280

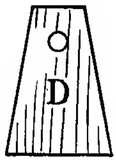


FIG. 281.

FIGS. 280–283. — Details of Interrupter.

its end when spool *E* is revolved. Drive a nail into base *A*, at *G*, and, after bending strip *F* as shown in Fig. 283, fasten it with brads upon the top of an upright made similar to *H* (Fig. 282), and nail this upright to the end of base *A*. The upper end of strip *F* must be bent so it will bear down upon the head of nail *G*.

The wire from the primary-coil which is as yet not con-

nected should be attached to nail *G*, and one battery wire should be connected to a binding-post plate *I* fastened to the lower end of strip *F*. Figure 283 shows how the binding-post plate is made out of a doubled piece of tin, with a hole punched through it for a small binding-screw.

This completes the interrupter. Mount it beside the induction-coil upon the base block, and connect it with the battery and the induction-coil, as shown in Fig. 274. Connect the battery cells in series. Two cells will be enough.

How the Interrupter Works. When you turn the crank of the interrupter, each nail in spool *E* raises the end of strip *F*, in passing it, thus breaking the electrical contact between it and the head of nail *G*. If the strip has been bent properly, it will spring back into contact with the head of nail *G*, and each time the contact is made, the person holding the handles will receive a shock. The strength of the current can be regulated somewhat by the speed with which the interrupter crank is turned. The shocks are stronger and more distinct when the crank is turned slowly.

Home-made electrical toys of a light construction are easily operated by a toy motor, when the motor and battery cell are not carried by the toy; but when both are transported, as in the case of a wagon, the construction must be very carefully worked out, or the motor will not be powerful enough to drive the wheels.

The Toy Electric Motor Truck shown in Fig. 286 is of light construction, the axle bearings produce very little

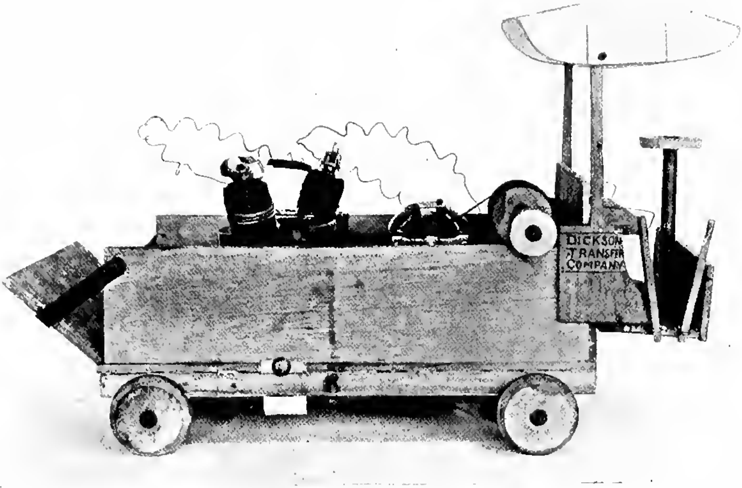


FIG. 286.—A TOY ELECTRIC MOTOR TRUCK.

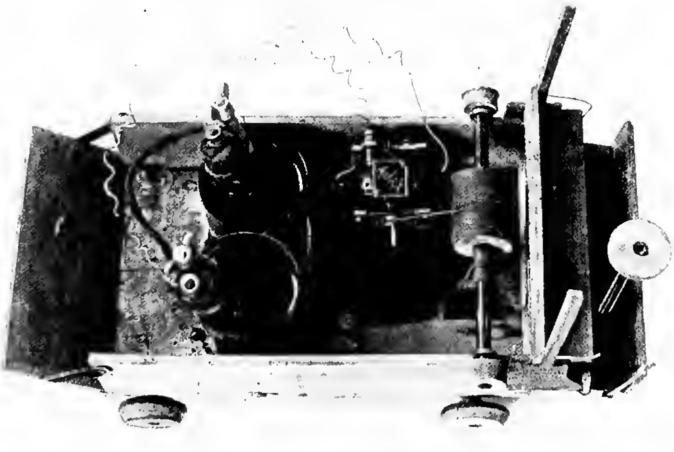


FIG. 287.—TOP VIEW OF ELECTRIC MOTOR TRUCK.

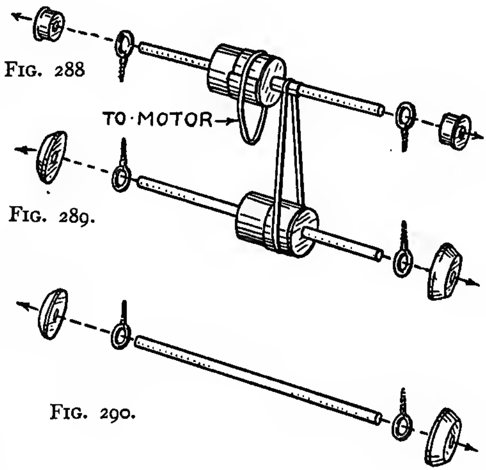
friction, and the battery is light and of a powerful type.

Get an oblong shaped cigar-box for the *bed* and *sides* of the truck, several large thread spools for *wheels* and *pulleys*, two small silk-thread spools, four lead-pencils, or sticks whittled perfectly round and ¼ inch in diameter, for *axles*, *belt-shaft*, and *steering-wheel post*, and six screw-eyes 5-16 inch in diameter for the *bearings*.

First, place the cigar-box in a wash-boiler or wash-tub of hot water, and allow it to remain there until the paper labels have soaked off or loosened sufficiently so they can be scraped off with a knife.

Then, after the box has thoroughly dried, cut the two strips *A* (Fig. 291), and fasten them to the bottom, one at each side. Screw the screw-eye axle bearings into these strips. Place them at equal distances from the ends of the strips.

The Wheels are made from the flange ends of the large spools. Figure 289 shows the front pencil axle. Slip the center portion of one



Figs. 288–290. — Details of Axle and Belt Shaft.

of the large spools on to this for a pulley, then stick the pencil ends through the screw-eyes in strips *A*, and glue the spool-end wheels on to them. The rear axle is like the front one, with the spool pulley omitted (Fig. 290).

The Upper Shaft shown in Fig. 288 supports a spool pulley like the one on the front axle, and its screw-eye bearings should be screwed into the top edge of the sides of the box (Fig. 287), directly over the front axle. Slip a silk-spool on to each end of this shaft to keep its ends from slipping out of the screw-eyes.

The Belts. As you will see by Figs. 287 and 291, the upper large pulley is belted to the motor pulley, and another belt extends from the upper shaft down to the pulley on the front axle. Rubber-bands make the best belts. Cut a hole through the bottom of the cigar-box for the belt extending from the upper shaft to the front axle to pass through. Screw the toy motor to the cigar-box with its pulley directly in line with the upper shaft pulley. Wrap the spool pulleys with bicycle-tape, to keep the rubber-band belts from slipping.

The Battery. A dry battery is too heavy for the motor truck to carry; so we must make a special battery. Two bi-chromate cells with glass tumblers to hold the solution, and zinc and carbon elements, prepared like those shown in Fig. 233, page 130, are of the best form. Cut an opening through the cigar-box large enough for the two tumblers to set in. Cut a strip of tin about 1 inch wide and 8 inches long, and bend it into a U-shaped hanger, to support the

tumbler bottoms. Slip the hanger ends under strips *A*, bend them against the sides of the box, and fasten with tacks (Figs. 291 and 292).

Figure 287 shows how the battery cells are connected. A small switch can be fastened to the side of the truck to shut off and turn on the current, but, instead, you can simply withdraw one pair of elements from its tumbler to shut off the current. When through playing with the truck, however, it is important to remove both pairs of elements and wash them off, because the bi-chromate solution attacks the zinc elements even when the current is not in use. As the bi-chromate solution stains very badly, it is advisable to operate the motor truck only where there is no danger of ruining anything in case some of the solution spills, as in the basement or workshop. If you wish to use a dry-cell instead of the pair of bi-chromate cells, you can place the cell upon the floor and make the wires connecting it to the motor long enough so the truck can run back and forth across a room.

FIG. 292.

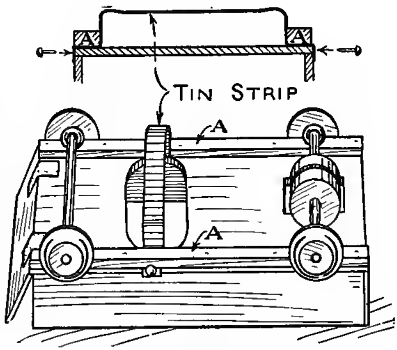


FIG. 291.

FIG. 291. — Plan of Motor Truck Bottom.
FIG. 292. — Section through Bottom.

The Seat and Canopy-Top details are shown in Fig. 293. Make these in about the proportion to the cigar-box shown in Fig. 286. Fasten the seat to the edge of the seat-back *B*

with glue and brads, and then fasten the side pieces *A* to the ends of the seat. The dashboard *E* is nailed to the bottom piece *D*, and *D* is nailed to the lower ends of side

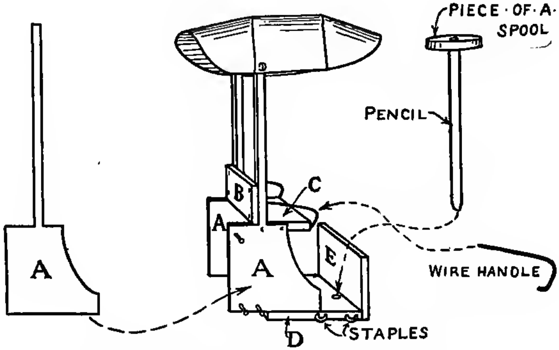


FIG. 293. — Details of Seat and Canopy-Top.

pieces *A*. Figure 294 shows the pattern for the canopy-top. Make it of light-weight cardboard, or heavy writing-paper. Slash the ends as shown; then turn down the corners, and lap and glue them to form the turned-down canopy ends. Fasten the ends to the canopy uprights with tacks.

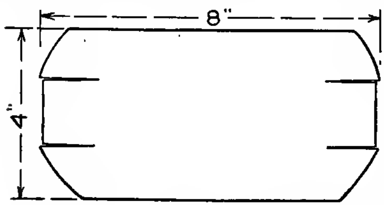


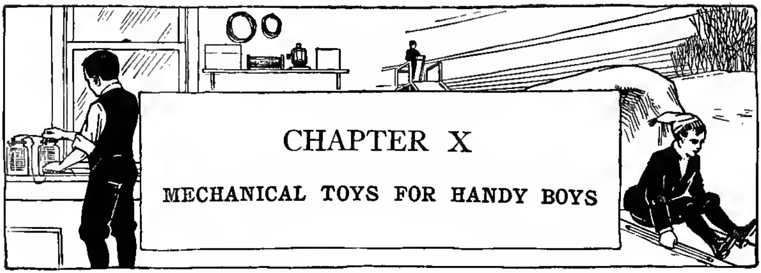
FIG. 294. — Pattern of Canopy-Top.

The Seat-Arms are pieces of bent wire, with their ends stuck into holes in the canopy uprights and front edge of the seat.

The Steering-Wheel is a section of a spool ⅛ inch thick, and is glued upon the end of a pencil or a stick. Run the

lower end of the pencil through a hole in the bottom of *D* (Fig. 293). For

The Levers, fasten two small sticks to the end of the bottom piece *D* with small staples.



CHAPTER X

MECHANICAL TOYS FOR HANDY BOYS

Aside from operating toys with a water-motor, the author and his friends used to have a great deal of fun rigging up a dozen or more wheels of different sizes, and belting one to another in such a way that they all ran at different speeds. Spools, clothes-line pulleys, bicycle wheels, sewing-machine wheels, and home-made wooden pulleys were used, and when all were set in motion they produced as much noise as is made in a small power plant — which to us was one of the fascinating features of the scheme. More power can be obtained with a toy water-motor than with a small electric motor, or a toy engine, and taken altogether it is one of the most useful toys that a boy can make.

The Toy Water-Motor shown in Fig. 295 may be operated in a bath-tub or a kitchen sink, but a laundry tub will generally be a more satisfactory place, because down in the laundry you will have more room in which to rig up the toys that you wish to operate, and between wash-days you will be in no one's way there.

The Motor Case. You can probably get a small grocery box for the *case* of your water-motor; if not it will be a simple matter to cut down a box. Figure 297 shows the

completed water-motor, and Fig. 298 a detail of the box case. A narrow strip should be removed from the top board of each side of the box, as shown in Fig. 298, or else a small strip should be nailed to the top edge of each end board, to form outlets for the waste water.

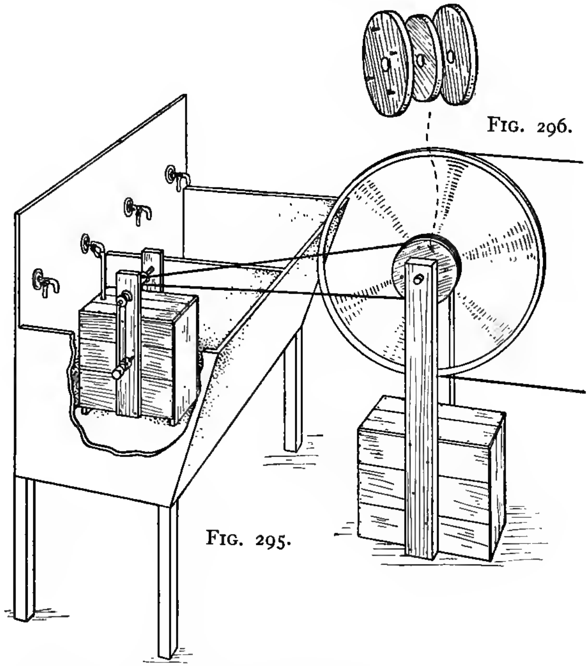


FIG. 296.

FIG. 295.

FIG. 295. — A Toy Water-Motor Operated in a Laundry Tub.
FIG. 296. — How to Make Pulleys.

The Water-Wheel is shown in detail in Figs. 300 and 301. The diameter of this should be several inches shorter than the height of the box. After cutting the two circular side

pieces of the wheel, and boring a center hole through each large enough for a broom-handle or curtain-pole shaft (*A*,

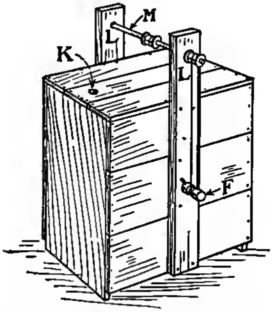


FIG. 297. — The Completed Water-Motor.

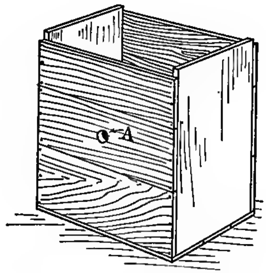


FIG. 298. — The Water-Motor Case.

Fig. 301), draw the lines *B* and *C* at right angles to one another, and lines *D* and *E* at an angle of 45 degrees to these.

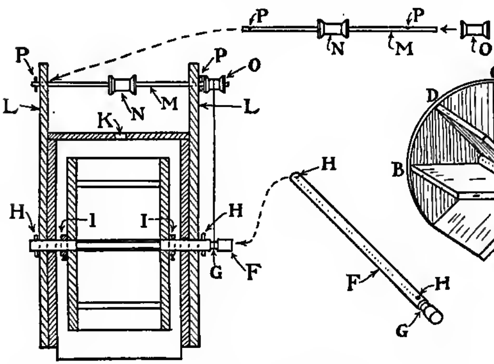


FIG. 299. — Cross-Section of Water-Motor.

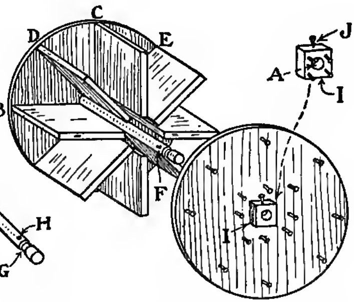


FIG. 300. — Detail of Water-Wheel.

The lines represent the centers of the wheel paddles and will be your guides in putting together the wheel. Cut the

paddles out of thin wood, and make them a trifle shorter than the lines *AB*, *AC*, *AD*, etc., and of the proper width to leave about ½ inch between the wheel ends and the box case, when the wheel is mounted in the case (Fig. 299). In assembling the wheel, first nail one end piece to each paddle (Fig. 300), then nail on the other end piece.

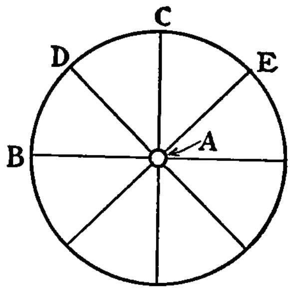


FIG. 301. — How to Lay Out the Water-Wheel Ends.

The Shaft *F* (Figs. 297, 299, and 300) should be enough longer than the width of the motor case to allow for cutting a pulley *G* on one end, and driving a pin *H* through the other end. To prepare the pulley, first make two cuts entirely around the shaft with a fine saw, then remove the wood between the cuts with a chisel. This cutting must be done very exactly, of course, or your pulley will not center on the shaft. Drill the holes *H* for pins (Fig. 299). Block *I* (Fig. 300) is for a short set-screw to keep the water-wheel from turning on the shaft. Make one of these for each end of the wheel. Bore hole *A* through the center of the block, drive screw *J* into one edge, and then nail the blocks to the ends of the wheel.

To Mount the Wheel, first slip it into the case, then slip the shaft through holes *A*, and when properly centered drive the set-screws *J* part way into the shaft.

Bore the hole *K* through the top of the motor case, about 1 inch inside of the line of the forward part of the

wheel. This hole should be of the exact size of the faucet from which you are going to obtain your water-power, and one end of a piece of rubber tubing should be slipped into it and the other end cut off so it will be of just the right length to reach the faucet. This tubing will prevent the water from striking the top of the case and splashing.

The Upper Shafting *M* and the uprights *L* (Figs. 297 and 299) are necessary only in case the water-motor sets down in a tub, and the toy to be operated cannot be belted directly to the pulley on the water-wheel shaft. The upper shafting can be placed high enough so the belt will clear the sides of the tub (Fig. 295). Cut the shaft *M* large enough to fit snugly in the holes in spools *N* and *O*, and drill the holes *P* for pins.

Figure 296 shows how you can prepare wooden

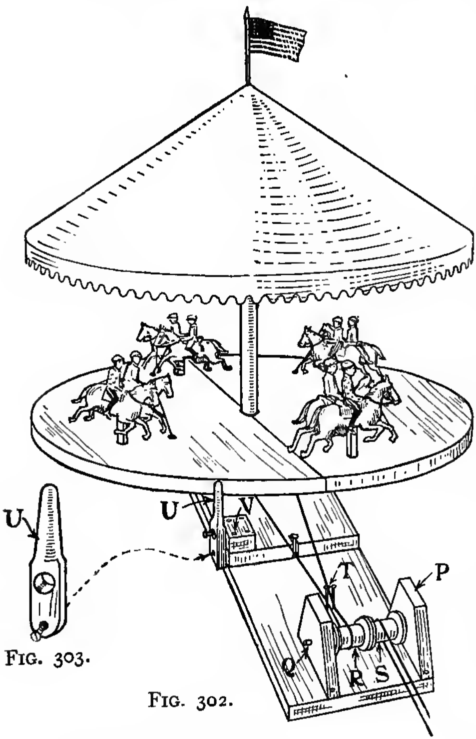


FIG. 303.

FIG. 302.

FIG. 302. — A Toy Merry-Go-Round.
FIG. 303. — Detail of Lever Control.

Pulleys for Gearing down or increasing the speed of your motor, and Fig. 295 suggests how one of these may be fastened to the side of a bicycle wheel, and the two supported on two uprights nailed to a box base. Suggestions for cutting wooden wheels are given on page 375.

A Toy Merry-Go-Round. This home-made mechanical toy, shown in Fig. 302, may be operated by a water-motor,

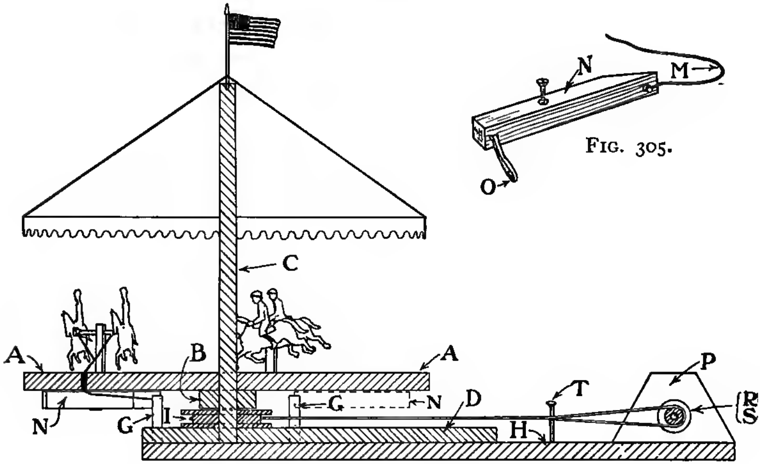


FIG. 305.

FIG. 304. — Section through Merry-Go-Round.
FIG. 305. — Detail of Trigger for Making Horses Gallop.

toy engine, or electric-motor, or by means of a crank turned by hand.

The Revolving Platform of the merry-go-round may be of any size that you wish to make it. That of the toy illustrated is 20 inches in diameter, and is made of two pieces of board 10 inches wide (*A*, Fig. 306), joined together at

the center with the board *B* (Fig. 306). A barrel-head might be used for the platform if you can find one; this would

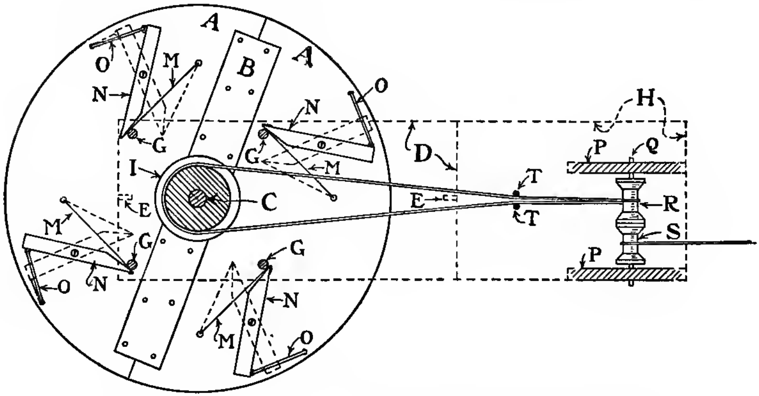


FIG. 306. — Plan of Under Side of Merry-Go-Round Platform.

save you the work of cutting the circular pieces. A hole must be bored through the center of the platform for the tent *center-pole C* — a piece of a broom-handle or curtain-pole. Fasten the center-pole in a hole bored through **The Base** *D*, near one end (Fig. 307). The base *D* is 8 inches wide and 18 inches long. Cut notches *E* in the ends, and fit the four wooden pins *G* in holes bored at equal distances from center-pole *C*. Cut pins *G* long enough so they

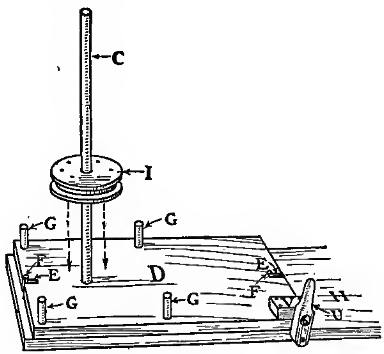


FIG. 307. — Platform Detail.

will project 2 inches above base *D*. The purpose of these pins will be understood later.

Base *D* sets upon *another base H* (Fig. 307), which is of equal width but about one-half again as long. The two

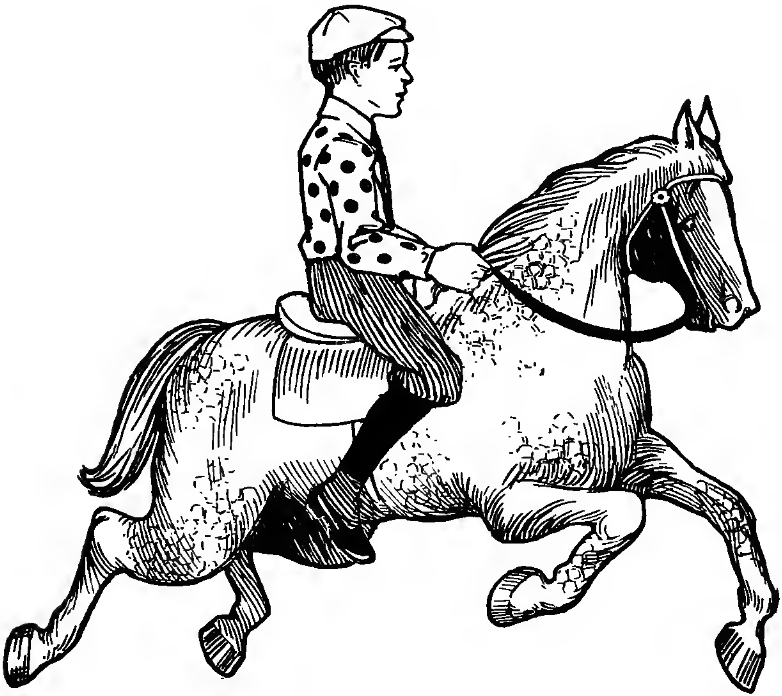


FIG. 308. — Horse and Rider.

base pieces are not fastened together, but the two nails *F* are driven through slots *E* in board *D* into board *H* in such a way that *D* will slide back and forth on *H* for a distance of about ½ inch; the reason for this is explained further on.

The Pulley *I* (Figs. 304, 306, and 307) is about 5 inches in diameter. The two outer pieces of this may be made of cigar-box wood; the center portion should be of ½-inch wood. Nail this pulley to the platform batten *B* (Figs. 304 and 306).

Figure 308 shows a full-size pattern of

The Horses and Riders. With a piece of thin paper make a careful tracing of this drawing; then transfer it eight times upon cardboard. Make the markings of the horse, and the face and clothes of the boy rider, with water-colors or crayons. After cutting out these cardboard horses and riders, paint the other side, then tack each to a strip of wood similar to *J* (Fig. 309). Each strip should have a hole drilled through it to fit a wooden axle *K*, and each axle should be slipped through a hole in an upright *L*, which in turn should be driven into a hole bored in the revolving platform (Fig. 304). The horses should be pivoted on axles *K* a trifle forward of their balancing point, as shown in Fig. 309.

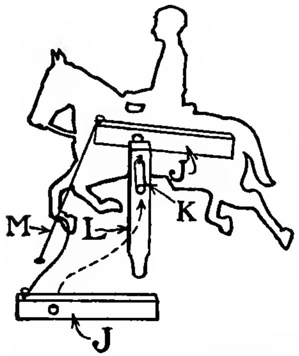


FIG. 309. — Detail for Mounting Horses.

The Horses are Made to Gallop by the *triggers N* (Figs. 304, 305, and 306), which are screwed to the under side of the merry-go-round platform in such positions that they are operated by pegs *G* as the platform revolves (Fig. 306). The cords *M* attached to the ends of sticks *J* (Fig. 309)

run through holes in the platform, and are tied to tacks in the ends of triggers *N* (Figs. 304, 305, and 306). Fasten the rubber-bands *O* to the opposite end of the triggers (Figs. 305 and 306), to spring them back into the positions indicated by dotted lines in Fig. 306, after they slide past pegs *G*.

When triggers *N* pull upon strings *M*, the horses rock forward; then, when the strings are released, the horses rock back again, on account of being pivoted forward of their centers of balance. Each pair of horses will go through four galloping movements upon each revolution of the platform. Triggers *N* must be very carefully pivoted, so pegs *G* will strike them just right.

The Pulley Supports *P* (Figs. 302, 304, and 306) are fastened to the projecting end of base *H*, in the proper position so the center of one of the two spool pulleys mounted upon the shaft *Q* (*R*, Fig. 306) will be in line with the center of the pulley *I*.

Use a strong twine for

Belts, and belt pulley *R* to pulley *I*, and pulley *S* to the water-motor, toy engine, or electric-motor used for power. The nails *T* in the base *H* (Figs. 302, 304, and 306) are necessary to guide the belt running from pulley *R* to pulley *I*, at the point where it twists.

The Control Lever *U* (Fig. 302, 303, and 307) shifts base *D*, backward and forward, loosening the belt running over pulleys *R* and *I* when moved in one direction, and tightening it when moved in the opposite direction. When this belt

is tightened, the merry-go-round is set in motion; and when slackened, the belt slips around pulley *R*, and the toy is brought to a stop, while the engine or motor runs free. Fasten the block *V* to the corner of base *D* (Figs. 302 and 307), drive a nail into its edge, and screw the lower end of lever *U* to the edge of base *H* in the proper position so the nail in the edge of block *V* will slide back and forth in the upper hole in lever *U*.

This completes the operating mechanism of the merry-go-round. Probably the triggers, and one or two other portions will require adjustment to make the toy run smoothly, but these are details that are easily taken care of.

The Tent for the merry-go-round may be made of tin or cardboard. Figure 310 shows how it should be cut, with a triangular piece sliced out of one side. Lap and fasten the two edges *W*, and attach the peak *X* to the top of the center-pole.

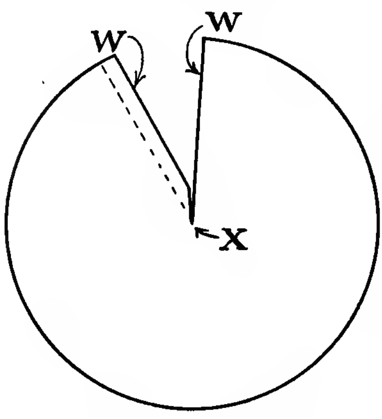


FIG. 310. — Tent Diagram.

More fun can be had with

A Toy Aeroplane of the form illustrated in Fig. 311 than with most of the forms of mechanical aeroplane toys sold in the toy stores, because it has several features that they have not. Start-

ing from the floor or a table, our aeroplane rises several feet in the air, and flies around and around a center-pole from which it is suspended. Figure 312 shows more clearly how simple the operation of the toy is. The center-pole *A* runs down through the top of a grocery box used for the base, and has a crank *C* upon its lower end by which to turn it. The arm *B* has a hole bored through it near one end for the center-pole to stick through, and is nailed to the center-pole. Cross-piece *D* has a small screw-eye screwed into each end (Fig. 313), and is nailed at its center to the outer end of arm B. The suspension-cords of the aeroplane run through the screw-eyes in crosspiece *D*, and are joined at *E* (Fig. 312); then a single cord connected at *E* extends along arm *B* to a screw-eye at *F*, and runs through

FIG. 311. — A Toy Aeroplane.

it and over to another screw-eye in the wooden block *G*, at *H*, to which it is tied.

How the Toy Aeroplane Works. When the center-pole is revolved by turning crank *C*, and block *G* is allowed to

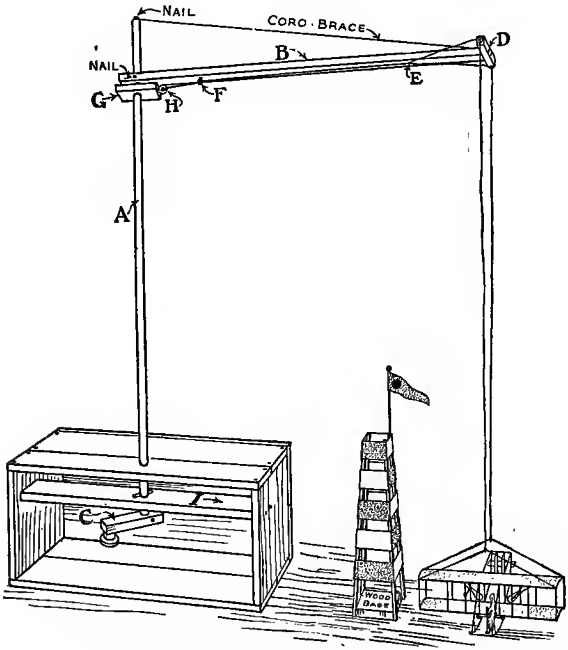


FIG. 312. — Detail of Toy Aeroplane.

revolve with the center-pole, the aeroplane simply runs along the floor or table; then, by reaching up to block *G* and sliding it down the center-pole, while the pole is revolving and the aeroplane is flying around its course, the suspension-cord will pull with the block, and the aeroplane will gradually rise in the air until, when block *G* has

been slipped down as far as it will go, the aeroplane will be nearly as high as the under side of arm *B*. Block *G* should be allowed to turn with the center-pole, of course, to keep the suspension-cord from winding itself about the pole.

To make the aeroplane descend, it is only necessary to push up block *G*, and by doing this quickly you can cause a spectacular descent.

The Construction of the Center Support is simple. A small grocery box should be used for the *base*, a piece of

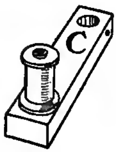


FIG. 314. — Crank.

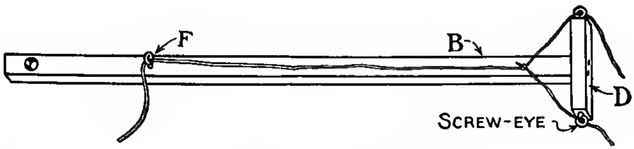


FIG. 313. — Horizontal Arm.

curtain-pole 3 feet 6 inches long should be obtained for the *center-pole*, and a board 1 inch thick will be needed out of which to cut the *arm* and other pieces. Bore the hole for the *center-pole* through one side of the box, in the center of its length and near the top edge, and bore another hole of the same size through the center of a 3- or 4-inch strip, equal to the inside length of the box, for the crosspiece *I* (Fig. 312).

Make a *crank* as shown in Fig. 314, using a wooden strip 8 inches long, boring a hole near one end for the center-pole to fit in, and fastening a spool near the other end for a

handle. Secure the crank to the center-pole with a nail, and bore a hole through the pole directly above crosspiece *I* for a wooden pin, the purpose of which will be to keep the pole from dropping below that point. Cut the *arm B* about 3 feet long and its crosspiece *D* 6 inches long (Fig. 313), and after nailing the crosspiece to the end of the arm, fasten the arm to the center-pole (Fig. 312). Cut block *G* 5 or 6 inches square, make a hole through its center large enough so it will slip around the center-pole freely, and screw a screw-eye into one edge to tie the aeroplane suspension-cord to.

The Aeroplane Model may be patterned after the type of machine you like best, and if you have a good photo-

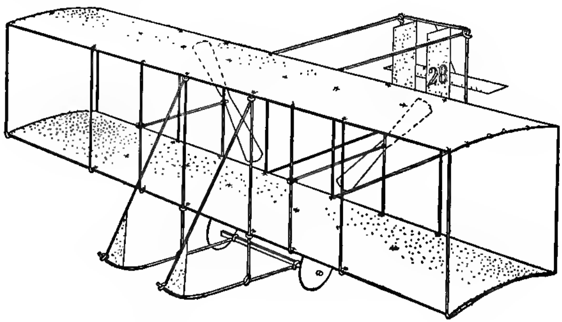
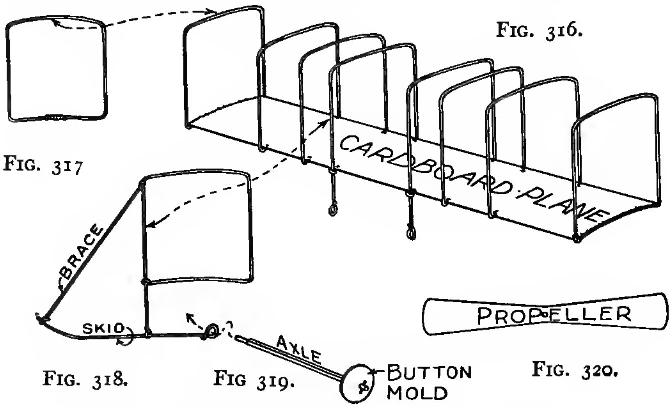


Fig. 315. — The Aeroplane Model.

graph you can use it to copy from. Figure 315 shows a suggestion for a Wright biplane model that is easily made. Figures 316, 317, and 318 show how the framework of this may be made of wire. Soft iron wire known as *stove-pipe*

wire can be bought at a hardware store at about 5 cents for a small coil, and this is what you should have for the *framework.* Use a pair of pincers for bending the wire. Make six *frames* similar to that shown in Fig. 317, about 2 inches square, with the top and bottom slightly curved. Lap the ends of the wire of each frame as shown, and bind with thread. The two center frames should be made similar



FIGS. 316–320. — Details of Aeroplane Model.

to these frames, but the front upright should extend about 1 inch below the bottom of the frame, and the end be bent into a hook to support the wire *skid* (Fig. 318). Make the skids of the proportion and shape shown, connect them to the wire frames, and brace with a diagonal piece to the top of the frames (Fig. 318). The rear end of each skid should be bent into a loop to hold the wooden *wheel-axle* (Fig. 319). Button-molds, or the sawed off ends of a spool, should be used for *wheels*, and the ends of the axle should be cut to

fit them. Drive pins through the axle ends to keep the wheels from coming off.

Make the *planes* of cardboard, cutting them 10 inches long and 2 inches wide. Space the wire frames about as shown in Fig. 316, and sew the cardboard planes to each. The rear portion of the framework, shown in Fig. 315, should be fastened to the two center frames.

Figure 320 shows the pattern for the *propellers*. Cut these out of cardboard, about 2 inches long, twist them until they have the proper warped surfaces for propellers, and then wire them to the third frame from each end, as shown in Fig. 315.

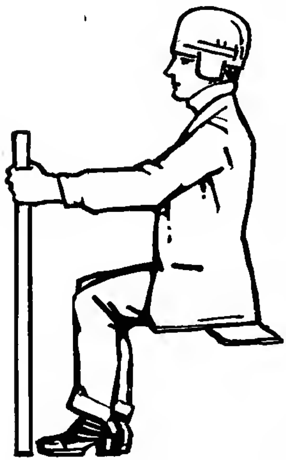
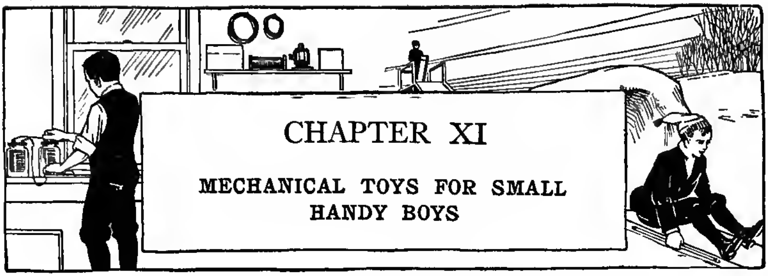


FIG. 321. — Pattern of Aviator.

The Aviator. Figure 321 shows a pattern for the aviator. Trace this off upon a piece of thin paper, and then transfer upon a piece of cardboard. Cut it out, bend out a flap on each side, as shown, and glue the flaps to the lower cardboard plane.

The Suspension-Cords (Figs. 312 and 313) are attached to the aeroplane, run through the screw-eyes, and tied to block *G*.

A Pylon, or tower such as is used to mark an aeroplane's course, may be built as shown in Figs. 311 and 312. Tack or glue five bands of paper around the uprights of this as shown. The alternate faces of the bands should be painted red, the others left white.



CHAPTER XI

MECHANICAL TOYS FOR SMALL HANDY BOYS

THOSE of you boys who have examined the little mechanical toys sold upon the street corners just before Christmas probably have been surprised to find how simply they are made, and perhaps it has never occurred to you that you might make toys equally as good for presents for your younger brothers, sisters, or cousins. Most of the smaller mechanical toys are not only easy to make, but they require materials which cost little and can usually be picked up at home. Sometimes it takes considerable thinking and planning to discover just the things which can be adapted to the various parts of toys; but that is where part of the fun of toy making comes in.

A Buzz-Saw Whirligig is an interesting toy (Fig. 322). Lay out a disk about 5 inches in diameter upon a piece of cardboard, locate the position for the spool-end on the center of each face, and make four rings outside of this. Divide the circumference of the disk into sixteen equal parts, and lay off the teeth as shown. (Fig. 325.) The spool-ends used for centers should have two holes drilled through them for the twisting cord to slip through, and should be fastened to the disk with glue or brads.

A cotton string is best for

Operating the Whirligig. After slipping it through the holes in the spool-ends, tie the ends together. To work the toy, slip the first finger of each hand through the loop of each end, and whirl the disk in one direction until the string is twisted from both ends as far as the center. Then pull firmly on the ends of the string, and the disk will whirl in the opposite direction until the string is untwisted and twisted up again in the opposite direction. As the strings twist, slacken your hold upon the ends, and when it has wound up tight pull again to make it whirl in the opposite direction. The disk should whirl very steadily when working right, and the knack of making the string twist so the disk will do so is attained with a little practice.

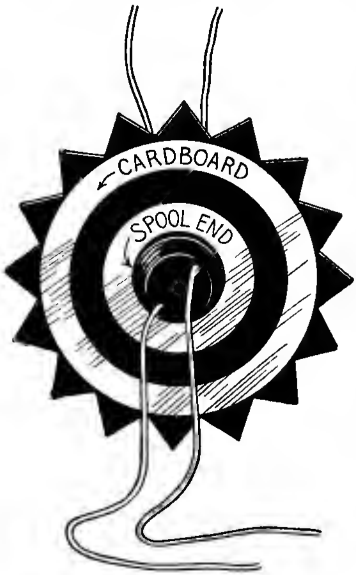


FIG. 325. — Detail of Buzz-saw Whirligig Shown in Fig. 322.

The Clog-Dancer (Fig. 323) is an easily made loose-jointed doll. His dancing-stage is a shingle or piece of stiff cardboard held on the edge of a chair beneath your knee. He is held by means of the string attached to his head, so that his feet rest lightly upon the stage, and he is made to jig by tapping the outer end of the stage with the free hand. With a little practice

Fig. 322.—The Buzz-saw whizzes when you twist the Cord.

Fig. 323.—The Eccentric Clog-dancer is a Circus in himself.

Fig. 324.—Pull the string and Jack jumps comically.

the figure can be made to go through the steps of the most eccentric clog-dancer.

The more grotesque the dancer's appearance is, the more amusing his dancing will be, so the cruder you make him the better. Figure 326 shows the working details for his construction. The center part of a thread-spool forms the *head*, and a spool-end and the rounded end of a broom-handle form the *hat*. These three pieces are nailed together. The *body* is a piece of a broom-handle, and a spool-end nailed to it forms the *shoulders*. Drive a nail into the end of the body, tie a string to this, and run the string up through the hole in the head, and out through a hole in the hat; tie the string to a fancy-work ring.

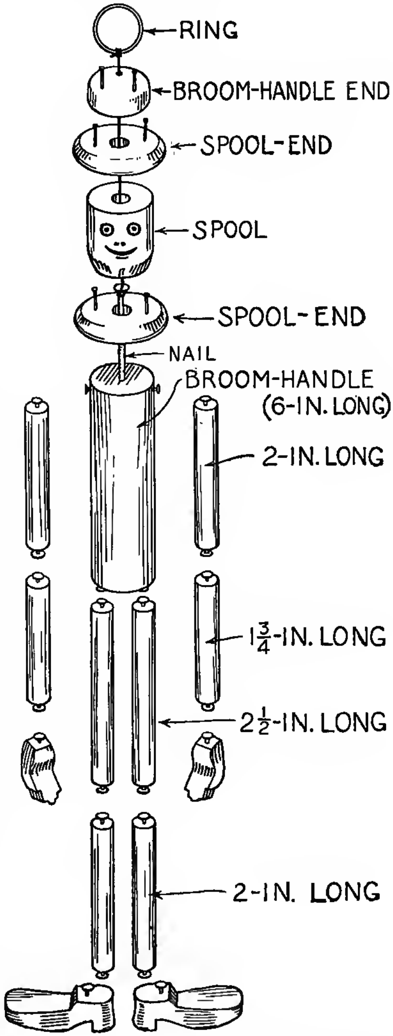


FIG. 326. — Details of Body of the Clog-Dancer Shown in Fig. 323.

The *arms* and *legs* are made of sticks whittled to

the lengths marked in Fig. 326, and about ¼ inch in diameter, and are jointed by driving tacks into their ends and connecting these with heavy linen thread. Figure 326 shows how the feet and hands are cut, and how tacks are driven into them for the thread connections. Paint the clog-dancer's body, arms, and legs white, his head, hands, and feet black, and mark his eyes, nose, and mouth upon his face in white.

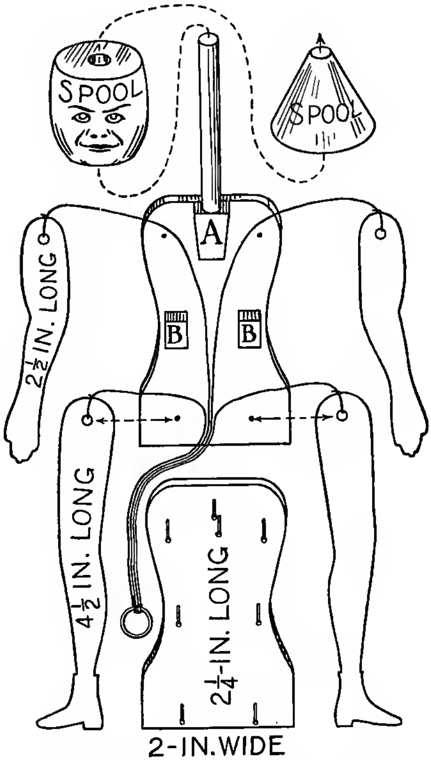


FIG. 327. — Details of Body of the Jumping-Jack Shown in Fig. 324.

A Toy Jumping-Jack is always amusing, and Fig. 324 shows a simply constructed home-made model. You will see by Fig. 327 how the figure is made. The peaked *hat* is half a spool tapered down from the end to the center; and the *head* is the center from a darning-cotton spool, shaped down at one end for a *neck*, and with eyes, nose, and mouth cut in on one side. Figure 327 shows the diagrams for the

front and back of the *body*, the *arms*, and the *legs*. These are cut out of cigar-box wood. Cut the neck stick *A* long enough to run through the head and hat, with a square block on the end to fit between the body pieces. The blocks *B* should be of the same thickness as block *A*. Bore the pivotal holes through the arms and legs in the positions shown, using a small gimlet or red-hot nail with which to do the boring, and tie a piece of heavy linen thread through each as shown. The arms and legs are pivoted on brads driven through the front of the body into the back.

When the body has been fastened together, bring the ends of the threads together, and tie to a small ring; also knot the threads close to the body to keep them together. In painting Jack, you might provide him with a red coat, blue trousers and a blue hat, white stockings, and black shoes.

A Cricket-Rattle is about the liveliest form of rattle ever devised (Fig. 328). After constructing one for your sister or brother, you probably will decide to make one for yourself. For this rattle, first prepare a *notched spool* (*A*, Fig. 330). The notches in this need not be cut as perfectly as shown, but the notches in one end of the spool must be exactly opposite those in the other end. Whittle the *handle* *B* to the shape and size shown, cut the strips *C* out of cigar-box wood, and prepare the block *D* as shown. The groove in the edge of *D* is cut of just the right width to receive the end of the wooden strip *E*. The length of *E* is best determined after nailing the ends of strips *C* to *D*, and slipping

the handle through the holes in strips *C* and spool *A*. It should extend from the groove in *D* into the notches in *A*.

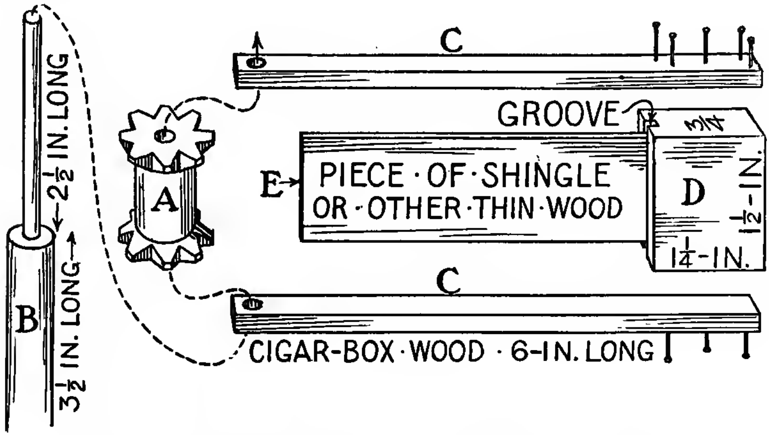


FIG. 330.—Details of the Noisy Cricket-Rattle Shown in Fig. 328.

Make it as wide as the spool is high. Paint the rattle red or blue.

The Turtle Toy which crawls along the floor when you alternately pull and slacken a thread that runs through its shell, has always been one of the most popular of mechanical toys, and you will be surprised to find how easily our home-made model shown in Fig. 329 is put together. The *shell* is a small tin mold such as is used for molding jellies. One about 4 inches long costs 10 cents. A mold having the form of a bunch of grapes is a pretty good form for the turtle shell, as you will see by the illustrations.

The *head*, the *tail*, and the four *feet* are cut out of tin from a can, and bent into the forms shown in Fig. 331. Then

Fig. 328.—Whirling the Cricket-rattle makes it chirp.

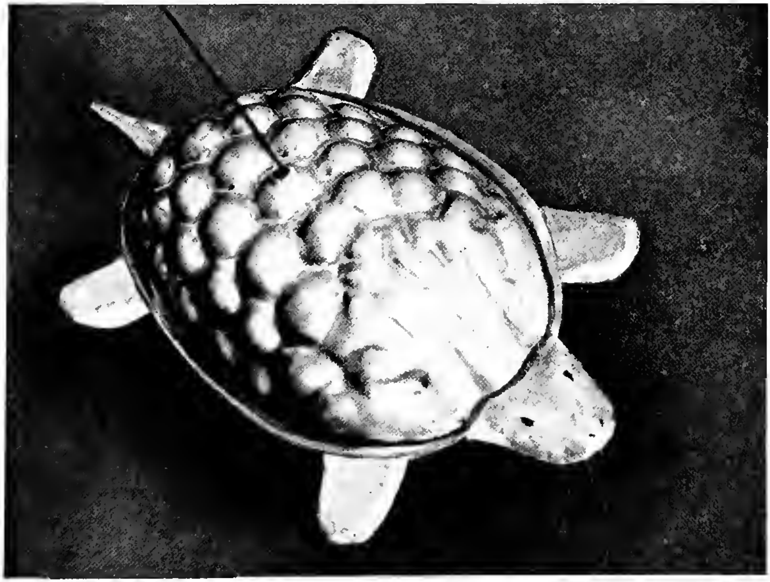


Fig. 329.—The Crawling Turtle's shell is a Jelly Mould.

slits are cut through the narrow rim of the mold, by piercing the tin with the point of a nail, at the proper places for attaching them, as shown in the small detail drawing, and the tab ends are pushed through the slits, bent over, and clinched with a pair of pincers.

A thread spool 1¼ inches long forms the *wheels* on which the turtle runs, and two rubber-bands 1½ inches long

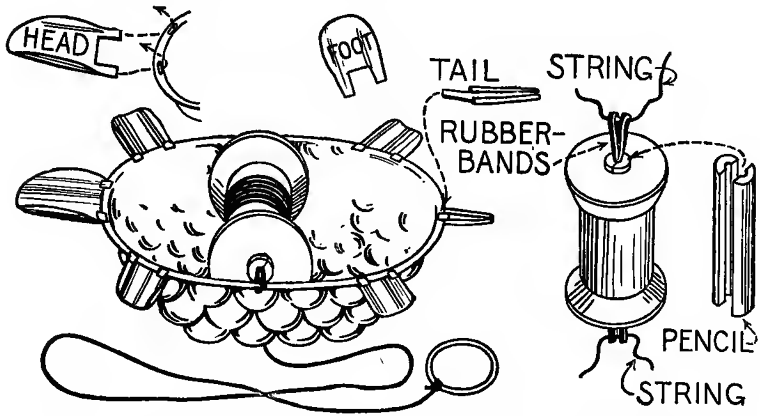


FIG. 331. FIG. 332.

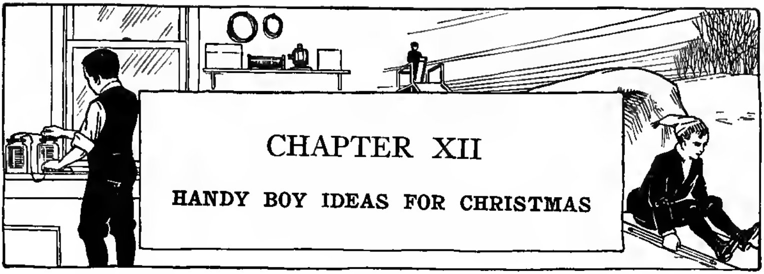
Fig. 331. — How Head, Feet and Tail are Attached to a Jelly Mold to Make the Turtle Shown in Fig. 329.

FIG. 332. — The Spool Wheels and the Rubber-Band which Propels them.

propel it. Cut a piece of a lead-pencil a trifle longer than the spool, split it into halves, remove the lead, and insert the rubber-bands in the groove; then slip the piece of pencil into the hole in the spool (Fig. 332). The rubber-band ends must project an equal distance beyond the spool-ends. Before fastening the spool to the tin mold shell, tie the end of a piece of heavy linen thread to its center, and then

wind about twenty turns about it. Pierce a hole through each side of the mold a trifle in front of the center, and after slipping pieces of string through the ends of the rubber-bands (Fig. 332), tie them through the holes pierced through the sides of the mold. Pierce a hole through the shell, directly over the center of the spool, slip the free end of the thread wound on the spool through this hole, and tie it to a fancy-work ring (Fig. 331).

To Make the Turtle Crawl, place it upon the floor, pull on the ring, and as the thread unwinds from the spool the rubber-bands will twist; then slacken the thread, and the turtle will crawl along the floor. As the rubber-bands untwist, the thread will wind up on the spool again. Continue pulling and slackening the thread alternately, and the turtle will continue to crawl.



CHAPTER XII

HANDY BOY IDEAS FOR CHRISTMAS

A HANDY boy may help to make the school or church Christmas entertainment a splendid success, if he knows how to build a Santa Claus fireplace, wire a Christmas tree with electric lights, and can add a new idea here and there in the program that will be a novelty to the audience. Then, too, he can fix up the home tree, play Santa Claus for the younger brother or sister, and get up some sort of a " show " that will entertain the family and guests. At Christmas time, the handy boy is a person very much in demand.

A brand-new way of introducing Santa Claus to an audience is to have him appear in a modern airship, instead of his old-fashioned sleigh drawn by reindeer. Figure 333 shows a novel scheme for

A Santa Claus Airship that is easily and quickly assembled. One boy can build it in less than a day, and two boys can do the work in a few hours' time.

The materials needed are a grocery box about 30 inches long, 20 inches wide, and 15 inches deep, for the *car*, a bicycle to support the car, two umbrellas for the *balloon ends*, several barrel hoops for the *balloon framework*, some heavy cord for *stays*, *guy-ropes*, etc., two old sheets for the

balloon covering, and several boards out of which to cut the *rudder*, *propeller*, *supports*, *braces*, etc.

The Car. Remove the bottom boards of the box to be used for the airship car, and nail two poles 10 feet long, or four poles 5 feet long, to the bottom edges of the sides (*A* and *B*, Fig. 334), so the ends will project the same distance beyond the ends of the box. Then construct the wedge-

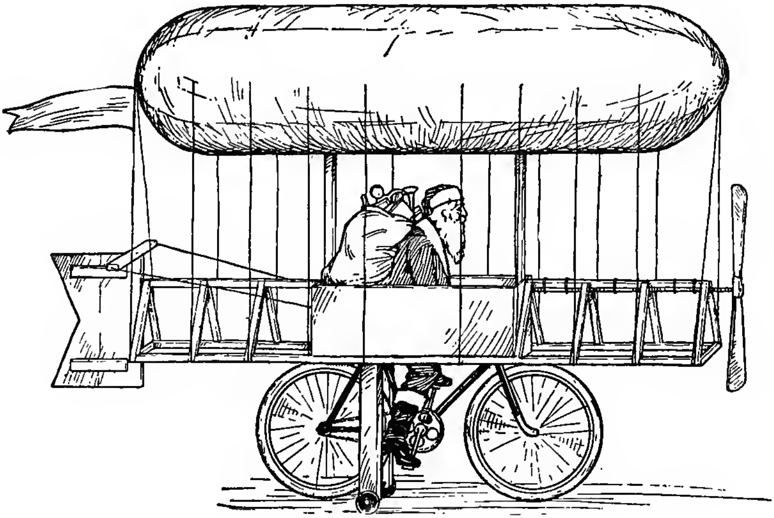


FIG. 333. — A Santa Claus Airship.

shaped framework shown in Fig. 333 upon these poles. The car is mounted upon the bicycle frame (Fig. 334). Fasten the two crosspieces *C* and *D* inside of the box, one either side of the bicycle frame, and then lash these crosspieces to the frame with cord. The bicycle would be hard to balance after the balloon framework has been mounted

above it, so it is necessary to fasten the *outriggers* shown in Fig. 333 on each side of the wheel. Any kind of small wheels will do for these outriggers. Nail uprights *E* and *F* (Fig. 334) to the sides of the box in line with the bicycle saddle, so their ends are about 1 inch above the ground, and fasten the wheels to them.

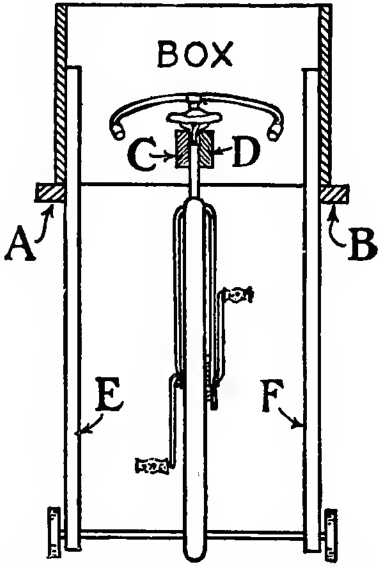


FIG. 334.—Section through Airship Car.

The Balloon Framework. The umbrellas used for the bow and stern of the balloon will not be damaged in the least, so you ought not to have any trouble in borrowing a couple. Open the umbrellas, and bind their handles to a 10-foot pole (*G*, Fig. 335). Then connect the ribs of the two umbrellas with cord as shown in Fig. 335. The cords cannot be tied to the rib ends very well, but there is a small eye in each through which you can run a needle and thread and sew each cord in place. Pull the connecting cords until the umbrella rib ends are bent in line with the sides of the balloon. The center barrel-hoop rib *H* is put in to keep the covering from sagging, and is made by splicing two hoops together; it is fastened to pole *G* by means of the two cross-pieces shown in the illustration. Uprights *I* and *J* support

the balloon framework, and should be of the proper length to bring the bottom of the balloon about 30 inches above the car, when nailed in place to the ends of the box. Nail pole *G* to the tops of uprights *I* and *J;* then nail braces *K*, *L*, *M*, *N*, and *O* in place as shown.

Perhaps your mother or sister will help you put on

The Balloon Covering. Two sheets or some unbleached muslin may be used for this. It is not necessary to injure

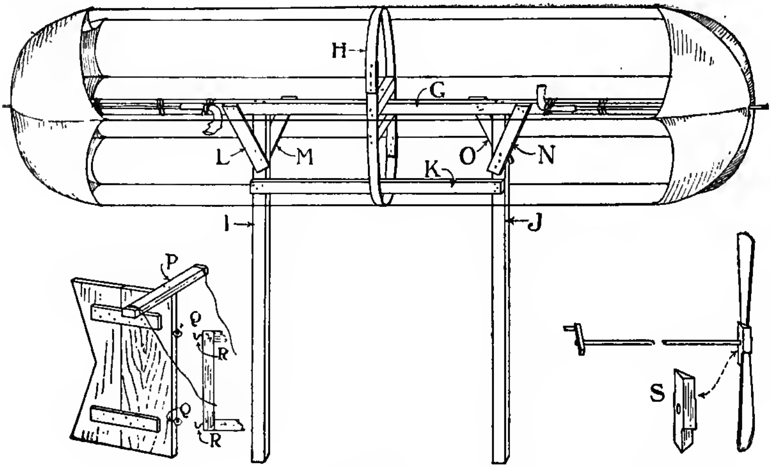


FIG. 336. FIG. 335. FIG. 337.

FIG. 335. — The Balloon Framework.
FIG. 336. — The Rudder.
FIG. 337. — The Propeller.

the umbrellas by sewing through them, for the cloth may be stretched tightly around them and sewed to itself.

Use a heavy wrapping-twine or a clothes-line for

The Stays and Guy-Ropes. Sew the upper ends to the balloon and tie the lower ends to the car framework.

The Rudder is shown in detail in Fig. 336. Make it out of two pieces of board, fastening the pieces together with battens as shown; then nail the crosspiece *P* to the top, and tie the *tiller ropes* to its ends. Screw two screw-eyes into the back edge of the rudder (*Q*, Fig. 336), and two hooks (*R*) into the end of the car framework for the eyes to hook on to. Run the tiller ropes through the back of the car, and tie them to the bicycle handle-bar.

The Propeller (Fig. 337) has two blades cut out of thin wood, which are nailed to a block of wood cut similar to *S*. The center hole shown in block *S* is bored for the propeller shaft to fit in. As the airship will not travel fast enough to make the propeller turn by wind pressure, it is necessary to fasten a crank upon the end of the propeller shaft, as shown in Fig. 337, so Santa Claus can turn it as he "flies." Cut a hole through the front of the car for the crank end of the propeller shaft to stick through, and make the shaft of just the right length so Santa Claus can reach the crank handily. Bind the shaft to the under side of the bow framework of the airship with cord, as shown in Fig. 333, but leave the cord loose enough so the rod will turn easily.

How the Airship should Enter. At your Christmas entertainment, Santa Claus should be concealed back of the audience until the proper time for him to make his appearance; then he should ride down an aisle to the front, where the stage or platform may be fixed to look like a roof-top, with a chimney for him to climb down. There should

be some way for him to get out of the side or bottom of the chimney without the audience seeing him; then he can make his entrance through a doorway, or come out of a fireplace built to one side of the room, and distribute his pack of gifts.

A Santa Claus Fireplace like the one illustrated in Fig. 338 is one of the simplest things in the world to build, and is an entirely new idea in false construction which has a number of improvements over the usual form of Santa Claus fireplace. The fireplace is built in a doorway, and on this account can be built as deep as you want it without extending the upper portion, or *chimney-breast*, farther into the room than is necessary to conceal the woodwork around the doorway. This not only reduces to a minimum the amount of lumber required for the framework, but saves time in putting it together. Then, too, the fireplace is of convenient form to climb in and out of, which will be appreciated by any 'portly Santa Claus whose stoutness, due to a pillow or two belted in at his waist-line, makes climbing more or less difficult. If the fireplace is built in a doorway between two rooms, it can be entered from the adjoining room, while if a closet or coat-room doorway is used, Santa Claus can be hidden within the closet or coat-room until he receives his cue to make his appearance.

Get a packing-case for

The Fireplace. That will save considerable work. One about 30 inches wide and 30 inches long is about right for a medium-sized doorway, but if the doorway to be utilized

FIG. 338. — This Santa Claus Fireplace is Built in a Doorway.

is a large one you can increase the size of the fireplace to whatever dimensions you wish to have it.

As shown in Fig. 339, the packing-case stands upon one side so the top will form the front opening of the fireplace; and the boards of the uppermost side of the box are removed, with the exception of the first one, which is left on or re-nailed on to keep the ends of the box from spreading apart.

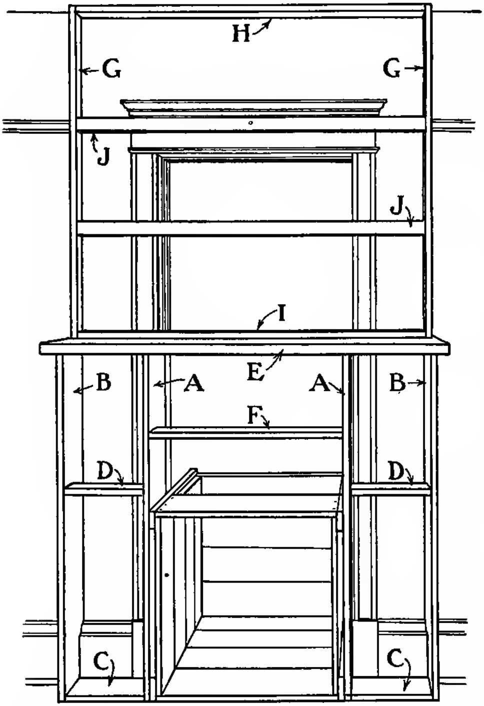


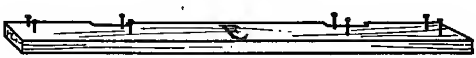
FIG. 339.—The Complete Framework of the Doorway Fireplace and Mantel.

The Mantel Framework. An average height for a mantel is 4 feet 9 inches. Cut the uprights *A* and *B* (Fig. 339) 2 inches shorter than this measurement, out of 6-inch boards, and connect uprights *A* to uprights *B* by means of the crosspieces *C* and *D*. Cut these crosspieces 12 inches long, and place pieces *C* between the lower ends and pieces *D* about halfway up. Then nail uprights

A to the ends of the packing-case, with their front edges on a line with the front edges of the box (Fig. 340).

The Mantel-Shelf (*E*, Figs. 339 and 341) is a piece of a 2 by 8 plank cut to the proper length to make a 2-inch pro-

FIG. 341.



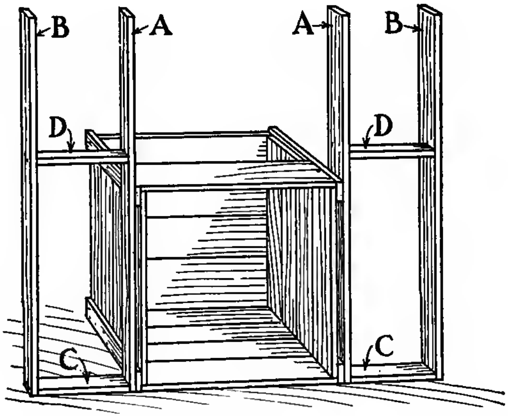


FIG. 340.
FIGS. 340 and 341.—Detail of Fireplace and Mantel.

jection over the tops of uprights *B* (Fig. 339). To set this shelf close to the wall, it is necessary to notch the back edge, as shown in Fig. 341, so it will fit around the door trim. Spike the shelf to the ends of uprights *A* and *B*. Fasten the crosspiece *F* between uprights *A*, halfway between the packing-case and the mantel-shelf, to nail the mantel facing to.

Fitting the Mantel Framework. Set the mantel framework in front of the doorway which you are going to use, and mark off the height and thickness of the wall baseboard upon the lower ends of uprights *B;* then cut these uprights to fit over the baseboard, so their back edges will set against the wall.

With the mantel framework set in position, the height of

The Upper Frame, which must fit between the shelf and the ceiling, can be measured accurately. Cut strips *G* to this length and 2 inches wide, and the horizontal strips *H*, *I*, and *J* equal in length to the distance between uprights *B* (Fig. 339). After fastening the strips together as shown in Fig. 342, with strips *J* placed flatwise so they will pass in front of the door trim, nail the bottom strip *I* to the mantel-shelf and drive a small finishing-nail through the center of the upper cross strip *J* into the door trim (Fig. 339).

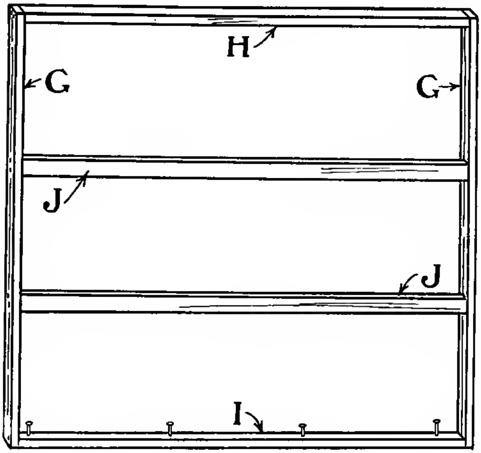


FIG. 342. — The Chimney-Breast Framework.

For a Hearth cut a piece of 12-inch board of a length

equal to the width of the mantel, and lay it on the floor close to the mantel.

The Covering Material may be heavy building-paper, tar-paper, or heavy wrapping-paper. The chimney-breast should be papered or painted to look as nearly as possible like the adjoining walls of the room. A picture-molding may be painted across the breast.

Paper printed in imitation of brickwork can be purchased in sheets 24 inches by 36 inches in size, at 6 cents a sheet, and it is much quicker to paste this upon the face of the mantel, and upon the inside of the fireplace, than to paint brickwork upon the covering material. But if you cannot conveniently get this, you will not find it difficult to mark off the brick courses with a pencil and a long, straight stick. Make the bricks 2 inches high and 8 inches long, and the mortar joints between about 3/8 inch wide. Paint the bricks red and the joints white or black. To give the fireplace brickwork a smoked appearance, it is a good idea to rub soot over it.

Christmas Tree Light Outfits. The safest way to light a Christmas tree is with electricity; it is also the most interesting way, and as the little lamps can be obtained in different colors the electrically lighted tree is much more pleasing to look upon than one lighted by candles.

Festoons of lights can be purchased wired ready to hang upon the tree, but every handy boy will wish to wire his own lamps, not only because it is interesting work, but because it is cheaper as well.

If your house, or the church or school in which the Christmas entertainment is to be held, is supplied with electric lighting, the simplest thing to do is to purchase *lamps* and *sockets* that can be used with that current (Figs. 345 and 346), and attach a *plug* to the end of the wire that may be screwed into one of the light-fixture sockets, just as the *drop-cord* of any electric lamp is connected (Fig. 344); but if there is no lighting current at hand you will have to depend upon battery cells.

Fig. 345.

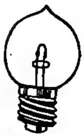


Fig. 345.—Miniature Lamp.
Fig. 346.—Miniature Socket.

The Battery Lamp Outfit shown in Fig. 343 consists of twelve miniature lamps of 1 candle-power each, and twelve dry-cells. This outfit could be operated with one-half as many cells, but the drain on them would be excessive and they would soon be exhausted. Another point in favor of using twelve is that by buying them in a dozen lot you will save about 7 cents on each cell. *No. 18* or *20 insulated bell-wire* may be used for the wiring of the battery outfit, but the *silk-covered double-conductor lamp-cord* sold for the purpose makes a neater appearance.

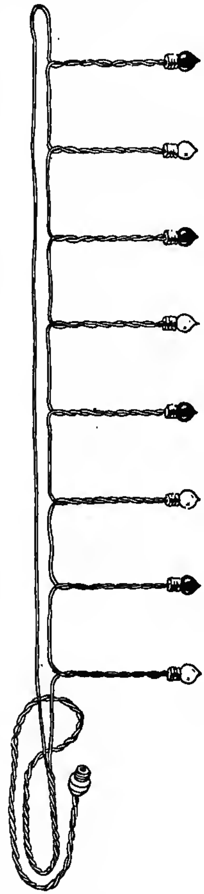


Fig. 344.—A "Circuit" Lamp Outfit.

The Cell Connections. The battery cells should be wired in *series-parallel*. This connection is described under *Methods of Connecting Battery Cells*, on page 135. You will notice that four rows of three cells each are connected in *series*, and then the four rows are connected in *parallel*.

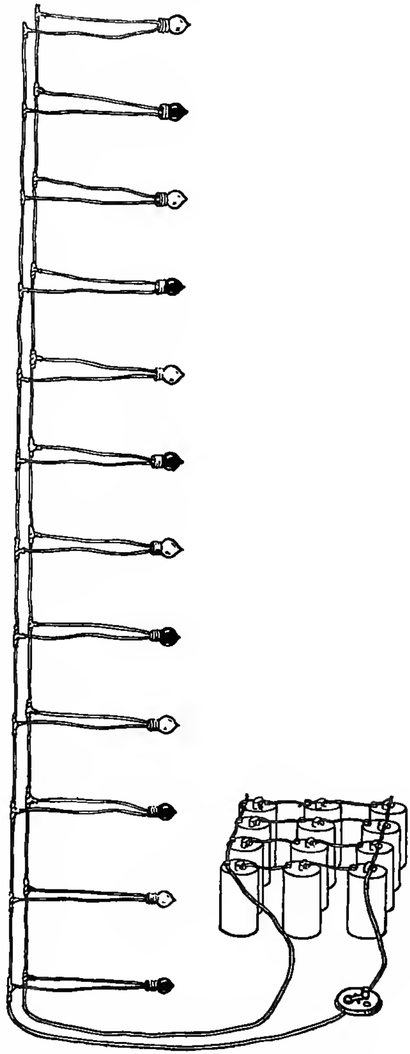


FIG. 343. — A Battery Lamp Outfit.

The Lamp Connections are wired in *parallel* — each lamp socket being connected to both wires coming from the battery. Space the lamps about 12 inches apart, and make the connecting wires long enough so the lamps can be placed well out upon the limbs of the Christmas tree. Be sure to scrape bare and clean the ends of all wires, so they will make good contact, and after splicing them

wrap them with bicycle-tape, or electrician's friction-tape.

A Switch should be set in between the battery and the lamps.

The Circuit Lamp Outfit is wired differently. These lamps must be connected in *series*, as shown in Fig. 344, and there must be eight, sixteen, or twenty-four lamps — a multiple of eight. Regular lamp *drop-cord* should be used for connecting the lamp sockets; this can be bought with a silk covering.

FIG. 348. FIG. 347.
FIGS. 347 and 348. — A Christmas Tree Standard that will Enclose Battery Cells.

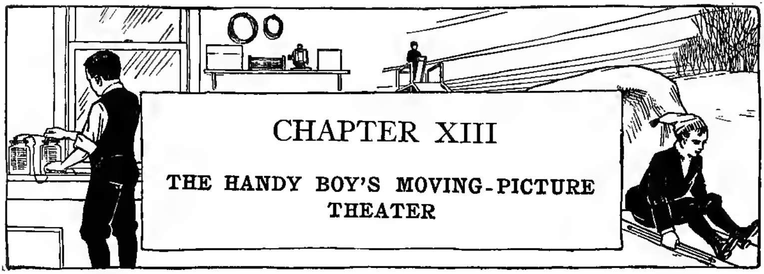
When Purchasing Lamps and Sockets, be sure to tell the dealer whether you want them for a battery outfit or a lighting-circuit outfit. Also have him test the lamps before leaving the store, because he will not replace broken or imperfect lamps brought back to him.

Figure 347 shows a good scheme for

A Christmas Tree Standard that will enclose the cells of a battery lamp outfit. A soap box will be large enough for a small tree. First make a tree standard in the usual way (Fig. 348), using two

pieces of 2-by-4 of a length equal to the inside width of the soap box. Cut a piece out of the center of each equal to the width and one-half the thickness of the other piece, so one will interlock with the other; then nail the two pieces together and cut a hole through the center large enough for the end of the tree (see *Boring Large Holes*, on page 70). Fasten this standard in the bottom of the box; remove part of one side of the box to make a door large enough to admit the battery cells, hinge it in place, and provide a hook and eye for fastening it shut. Fit the cover boards to the box top, and cut a hole through them directly over that in the standard, for the end of the tree to run through.

The battery switch should be fastened to the top of the box where it can easily be reached.



CHAPTER XIII

THE HANDY BOY'S MOVING-PICTURE THEATER

EVERY handy boy can give moving-picture shows at home after constructing his moving-picture theater in the manner described in this chapter. The theater is easy to build, and you will find the work very interesting; while planning new ideas for "movies," and developing them, will furnish enough additional occupation to keep you from growing tired of the toy.

The plan for this miniature moving-picture theater has been developed from the old-time *panorama show*, with several new features added to produce as nearly as possible the moving-picture effects.

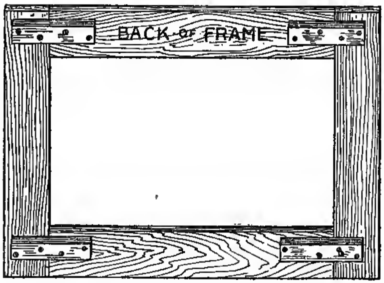


FIG. 349. — Make a Frame like this for the Front of the Stage if you Cannot Get a Gilt Picture Frame.

An old picture-frame like that shown in Fig. 357, with an opening about 16 by 30 inches in size, will form

A Splendid Proscenium — just like that of real theaters; but, if you cannot get one of these, a frame constructed similar to that shown in

Fig. 349 will serve the purpose just as well. Cover the front of this frame with tin-foil or colored paper.

Having a frame of the above proportions, prepare a box similar to that shown in Fig. 350 for

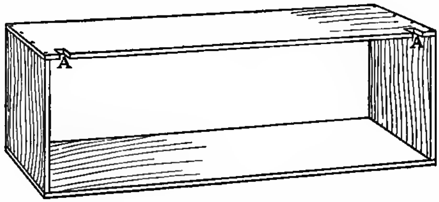


FIG. 350. — Make a Box like this for the Stage Framework.

The Stage Framework. Make this about 18 inches high, 48 inches long, and 8 inches deep. If you cannot find a box of these dimensions you can easily cut down a larger box.

The Picture Rollers. Notch one edge of the top of the box 1½ inches from each end, making the notches 1 inch square (*A*, Figs. 350, 351, and 352); then prepare the

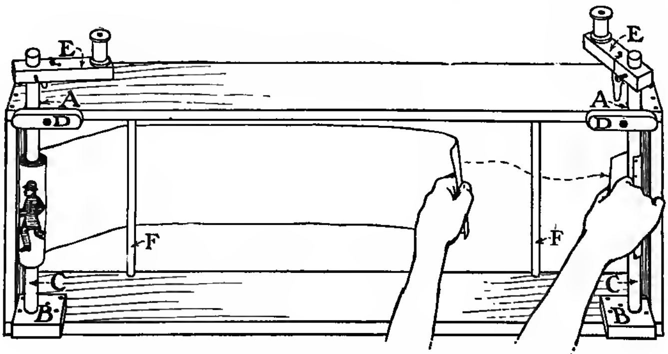


FIG. 351. — View from Rear before Front Frame is Attached.

sockets B (Figs. 351 and 353) 3 inches square, bore a 1-inch hole through each, and screw or nail them to the stage framework so the holes will come directly under slots *A*,

as shown in Fig. 351. The slots and sockets are made to receive the picture rollers, which are cut from curtain-poles or the straight ends of broom-handles. The rollers should be about 20 inches long, so as to project about 3 inches above the top of the stage framework when put in place. Prepare a number of these rollers. One will be needed for each set of pictures, and then there should be one additional one.

Tack a piece of cloth about 8 inches square to each roller about 4 inches from the lower end (Fig. 354) to pin the end

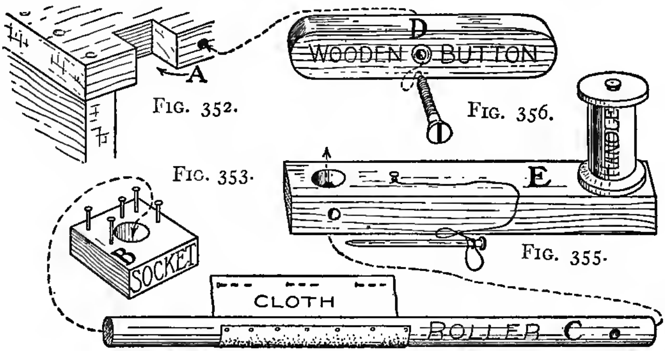


FIG. 352. — Notch the Top Edge of Stage Framework like this for Upper End of Rollers.
FIG. 353. — Socket Block for Lower End of Rollers.
FIG. 354. — Broom-Handle Roller with Cloth Strip for Attachment of Picture "Films."
FIG. 355. — Crank for Turning Picture Rollers.
FIG. 356. — Button for Holding Upper End of Rollers in Position.

of the *picture "films"* to. Prepare the two *buttons D* (Fig. 351) as shown in Fig. 356, bore a hole through the center of each, and screw them to the top edge of the stage frame-

work in the proper position for one end to lap over the slots when they are turned horizontally (Fig. 351).

Prepare the *cranks E* (Fig. 351) as shown in Fig. 355. You can get along with one of these, but two will save the bother of transferring from one roller to another to roll back a strip of pictures. The crank consists of a short strip of wood with a hole equal to the size of the roller bored through it near one end, and a large spool pivoted near the other end for a handle. The hole shown in the edge of the strip (Fig. 355) should be bored through to the opposite side, and a hole of the same size should be bored through each roller, about 1 inch from the upper end (Fig. 354), so that when the crank is slipped over a roller a nail can be slipped through the holes to pin the crank in place. Suspend the nail from the crank by means of a piece of string, as shown, to prevent losing it.

The Picture "Film" Guide Sticks *F* (Fig. 351) may be pivoted in such a way that they will revolve like the rollers, though it is not necessary for them to revolve, because their purpose is merely to hold the strip of pictures close to the front of the stage, and the cloth will run over them smoothly enough even though they do not turn. Place these sticks close to the front edge of the stage framework, about 3 inches each side of where the front frame opening will come.

Attaching the Proscenium. In order not to damage the picture-frame proscenium in attaching it to the stage framework, set screw-eyes into its back and into the stage framework, and connect these screw-eyes with wire. Center the

picture-frame on the stage framework as shown in Fig. 357. Place your theater upon a table or packing-case with the framework close to the edge, so the picture-frame will hang down as shown in Fig. 357.

The Picture "Films" should be made of white cheese-cloth or muslin (old sheeting will do nicely). Cut the

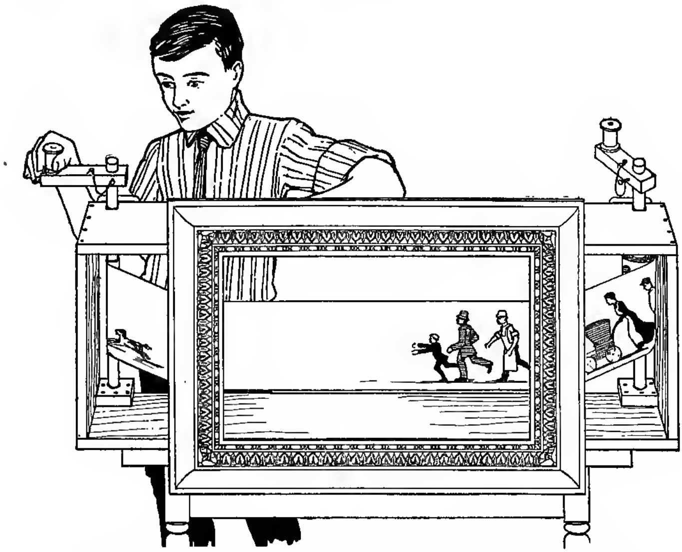


FIG. 357. — The Completed Moving-Picture Theater.

The space above and below the picture strip may be filled in with strips of white cloth or cardboard, but sets of scenery like those shown in Figs. 358-361 make the pictures more interesting.

strips about 8 inches wide, and sew together as many lengths as you find necessary for the set of pictures you plan. Not many years ago there was a scarcity of picture material for panorama shows, and the matter of finding what was needed was often a harder job for a boy than making the stage and other equipment. Nowadays, however, there is

an unlimited assortment of pictures from which to make selections, in magazines and newspapers, some of which are in color. Black and white pictures are easily colored with crayons or painted with water-colors.

Preparing a Scenario. Select a subject for your set of pictures, then work out an outline of the *scenes* to be pictured. Of course the subject must be something very simple. Perhaps you can think of a set of pictures which you have seen at a moving-picture show that can be worked out in a simplified form.

As a suggestion for a starter, suppose you choose "A Dog Chase" for your subject. This is the way to go about

Preparing the Pictures. Hunt up a picture of a dog running as fast as his legs will carry him, and paste it upon one of your cloth strips; then select pictures of boys, girls, men, and women, on foot, in automobiles, and in other vehicles (all side-view pictures), and, after leaving a space of about 2 feet behind the dog, arrange the pictures one after another in some ridiculous manner. For instance, you might start the chase with a small boy, then have a policeman running behind the boy, then a butcher chasing after the policeman, behind him a motorcyclist, and following the motorcyclist a baseball player, a doctor, a lady pushing a baby carriage. An automobile might be inserted, and a tiger, a lion, and one or two other animals might be shown springing at some of the pursuers or holding on to their coat-tails. Draw upon your imagination, and you will be

able to produce something decidedly startling, funny, and ingenious.

Scenery. The picture-frame opening above and below the picture strip must be filled up so the audience will not see the operator. He would be seen, of course, if the openings were left as in Fig. 357. The matter may be taken care of by tacking strips of white cloth or cardboard to the back of the picture-frame above and below the picture strip. But a better idea, and one which is easily carried out, is to prepare sets of scenery. These will add "atmosphere" to your pictures, and make them decidedly more interesting. The scenery may be prepared very roughly with crayons upon cardboard. Cardboard boxes may be broken up for material, and if you haven't enough boxes at hand they can be had for the asking at any dry goods store. If the cardboard is colored, paste white paper over one side for a working surface.

By making scenery, it is possible to use one strip of pictures for several scenes. Taking "A Dog Chase" — the subject suggested above — for example, you might prepare the four scenes shown in Figs. 358 to 361. The first of these (Fig. 358) shows

A Street Scene with a house at the left, which makes a good setting for the start of the dog chase. The dog, followed by its pursuers, should be shown in this scene dashing down the street and in through the front door of the house at the left. While it would be an unusual sight to see automobiles and other vehicles going through houses, in every-

day life, it is not in moving-pictures. The effect of the figures actually going into the house may be bettered by locating and cutting a window where shown, so the audience will see the figures passing it.

Figure 359 shows

A Roof Scene with the dog sitting upon the edge of a roof. This should be shown next. Leave to your audience's

FIG. 358. — Street Scene.

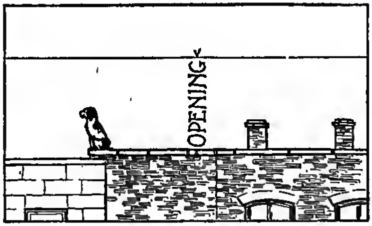


FIG. 359. — Roof-Top Scene.

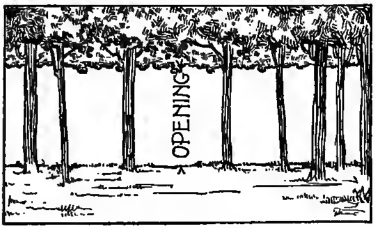


FIG. 360. — Forest Scene.

FIG. 361. — The Captured Dog.

FIGS. 358-361. — Scenery for Moving-Picture Story Entitled " A Dog Chase."

imagination the question of how the dog got up there. In an instant the dog should be seen leaping off the roof, and then the pursuers should dash across the roof tops and one by one leap after the dog. Allow the audience to imagine how the automobiles, carriages, and motorcycles, carrying the pursuers, reached the roof tops.

A picture showing a dog in a sitting position must be selected for the runaway dog in this scene. Figure 362 shows how the piece of cardboard upon which the dog is pasted should extend far enough below the dog's feet to provide a piece that can be pivoted by means of thread to the back of the roof scenery, and how a fine thread should be fastened to the head by means of which the operator can swing the dog down out of sight when it is time for it to leap.

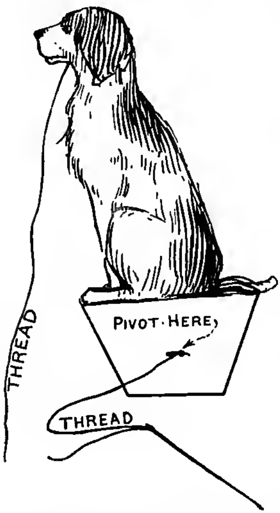


Fig. 362. — How Figures may be Pivoted to the Scenery so they can be Moved.

The pursuers will not leap from the roof as gracefully as the dog will, but the operator can make them appear to drop, by taking hold of the bottom of the cloth strip, directly below each figure, as it leaves the roof, and pulling it down slightly.

The Forest Scene (Fig. 360) shows the dog with its pursuers still hot upon its trail, and in the fourth and last scene is shown

The Captured Dog with all of the figures who took part in the chase and capture grouped around him. If any question is raised as to why the actual capture is not pictured, you can explain that this exciting portion of the "film" has been censored by the "Board of Censorship."

You will require a new set of figures for this fourth scene,

and a piece of cardboard of the size of the frame opening upon which to arrange and paste them. Very likely you will not be able to secure pictures of the same characters used in the other "film," but you will find other pictures that will do equally as well. Show the dog in the center of the group. Pivot its head to its body with thread, and

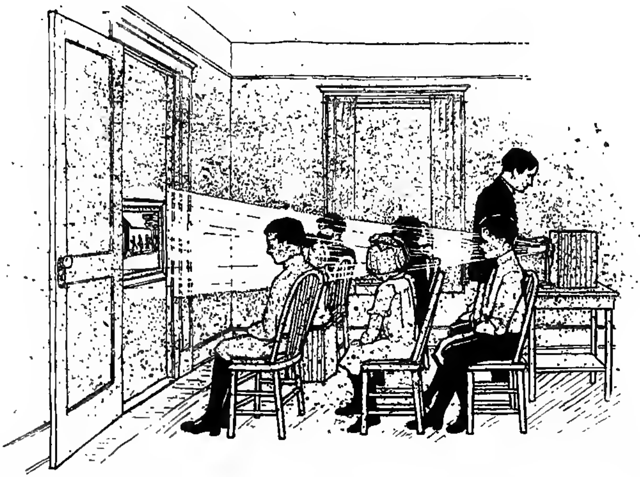


FIG. 363. — By Placing the Moving Picture Theater in a Doorway, as above, the Door may be Closed while Scenes are being Changed.

attach a piece of thread so that by pulling it the operator may make the dog raise and lower its head. By using this method of

Pivoting Figures, and parts of figures, so they may be moved, your pictures will appear very much more realistic.

When all is ready for a performance, place the table or box on which you set the theater for exhibition, inside of

a doorway, and hang a sheet or drapery above and below the picture-frame as shown in Fig. 363, to conceal the operator and the stage framework. By using a doorway for the theater, the cloth covering can easily be put up, and at the same time the door may be closed when you change from one set of pictures to another, so the audience will not see you changing the scenery.

The Imitation Moving-Picture Projector, from which the pictures will be supposed to be projected upon the "screen," should be placed in back of the audience (Fig. 363). The light from this illuminates the pictures. Figure 364 shows a front view of the lantern. Make the box like the *Signal Telegraph Lantern* shown in Figs. 528 and 529, page 336, with an opening $2\frac{1}{2}$ inches in diameter cut through the front.

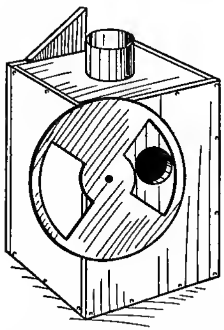


Fig. 364.

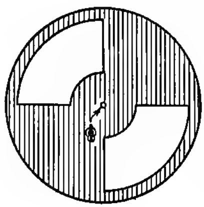
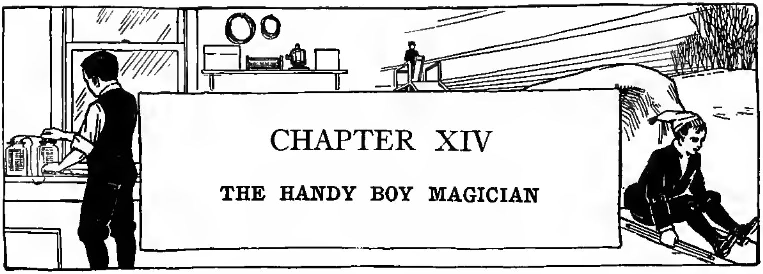


Fig. 365.

Fig. 364.—The Imitation Moving-Picture Projector.
Fig. 365.—Disk for Producing the Flickering Light Effect.

Prepare a cardboard disk similar to that shown in Fig. 365, with two openings cut through it in the places shown, and pivot it with a screw to the front of the lantern box so the openings will pass the hole in the lantern when the disk is turned. By whirling this disk, and thus intercepting the lantern rays intermittently,

the flickering effect of regular moving-pictures will be produced upon your picture "screen," and this will add the finishing touch of realism to your home-made moving-pictures.



CHAPTER XIV

THE HANDY BOY MAGICIAN

HOME magic is splendid material for a one-boy entertainment, and it requires no apparatus other than what a handy boy can make himself. In this and the following chapter are shown some of the best of the simpler, easily performed magical tricks, which when carefully prepared make a most interesting magical entertainment.

To be successful in the art of conjuring, you must first of all acquire patience, for only by so doing will it be possible to master those little movements of the hands necessary to deceive the sharp eyes of a critical audience. Very often the simplest trick is the most baffling, but its success is then generally due entirely to the cleverness with which it is performed. So it is of great importance to practise each trick repeatedly before presenting it, until you have mastered every step very thoroughly, and can go through with it in a graceful manner, without a single blunder.

First of all, a boy magician needs

A Side-Table on which to keep his various pieces of apparatus, and on which to perform some of his tricks. Most magicians have several side-tables on their stage. Any small table will serve your purpose, but a table like those

used by magicians will have a more professional appearance, and I advise you to make one. As shown in Fig. 366, the top of our home-made table is a shallow box, and this is supported upon a broom-handle, or piece of curtain-pole, mounted upon a base made like a Christmas-tree standard. The open end of the box forms a convenient pocket for slipping things into at various times, and this end must be kept turned away from the view of the audience. Cover the top and sides of the box with red cloth, or red paper, and slash the lower edge of the side covering, as shown, for fringe.

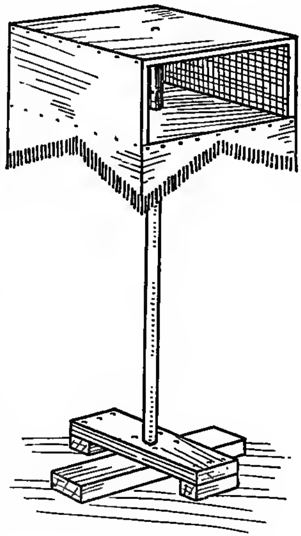


Fig. 366. — A Side-Table

A Larger Table is shown in Fig. 396, and described on page 242.

A Magic-Wand is indispensable, of course, because without its aid a magician is shorn of his magical powers. A piece of a flag-staff, a carpenter's dowel-stick, or a piece of bamboo fishing-pole, 14 inches long and about $\frac{1}{4}$ inch in diameter, should be obtained for this. Paint the wand black.

The Egg-and-Handkerchief Trick. After exposing both sides of a handkerchief to the view of the audience, the boy magician folds the handkerchief, and then causes an egg to slide out of one end of the fold into a hat.

This is how the trick is performed. The egg is *blown*, to make it light, and the blown shell is suspended on one end of a thread attached to the center of one edge of a large handkerchief (Fig. 367). The thread must be about 3 inches shorter than the distance across the handkerchief. To blow the egg, pierce a small hole through each end of the shell, with a pin, and then blow through one end until the contents have entirely run out of the hole in the opposite end. Run the end of the thread through the holes, and with a small piece of white court-plaster stick the thread to the shell. With care, the court-plaster can be put on so as to conceal the holes in the shell perfectly.

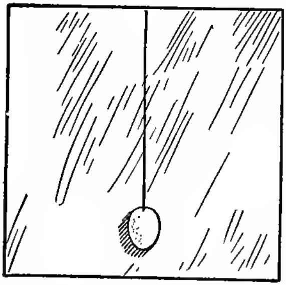


Fig. 367. — For the Egg-and-Handkerchief Trick.

In performing the trick, place a hat upon the side-table, and inform your audience that you will cause an egg to drop from an ordinary handkerchief into the hat. Hold the handkerchief as shown in Fig. 368, with the egg held and concealed in the left hand; then, by crossing the arms as shown in Fig. 369, turn the handkerchief about so the audience may view the other side. Catch between your teeth the corner held by the right hand (Fig. 370), slide the right hand along the top edge to the center, release your hold on the egg, and fold the handkerchief in half, folding it toward you with the egg upon the inside of the fold. Hold the folded handkerchief by the corners, horizontally

(Fig. 371), and allow the egg to roll out of the open end into the hat.

The Climbing Bar of Silver. The bar of "silver" slides up or down a cord, responding to the commands of the

FIG. 368.

FIG. 369.

FIG. 370.

FIG. 371.

FIGS. 368–371. — How the Egg-and-Handkerchief Trick is Performed.

magician (Fig. 372). Figure 373 shows the construction of the bar. Take a 6-inch piece of a small mailing-tube, and cut a wooden plug to fit each end (*A*, Fig. 373). Cut the cord *B* 8 inches long, tie a fancy-work ring to one end, and slip

the other end through a hole in the center of the top plug; cut cord C 12 inches long, slip one end through a hole pierced near the bottom of the tube, knot that end outside of the tube, and slip the other end through the ring on cord B and then through a hole in the bottom plug. Fasten the plugs in the tube ends with glue or tacks, and then cover the side and ends of the tube with tin-foil.

FIG. 372.

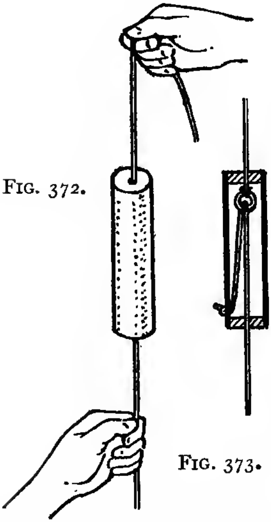


FIG. 373.

FIG. 372.—The Climbing Bar of Silver.

FIG. 373.—Section through Bar of Silver.

By examining Fig. 373, you will see that it is only necessary to pull the ends of both cords to make the bar climb, and to slacken the cords to make the bar slide down. In exhibiting this trick, first pull on cord C, then on cord B, to show the audience that the cord slides through the tube freely.

The Marked Coin Trick. The boy magician borrows a coin from some one in the audience, marks it for identification later, drops it into a tin can, and puts the cover on the can. Then he walks over to a table and finds the coin inside of the inside box of a nest of three covered boxes. He passes the coin among the audience to show that it is the same marked coin that was loaned to him.

This is the explanation of how the trick is done. A slot

is cut through the side of the can into which the coin is to be dropped, just above the tin bottom (Fig. 374), and as soon as the covered can shaken to show the audience that the coin is still there, the can is so tipped that the coin slides out through the slot into your hand.

Fig. 375.

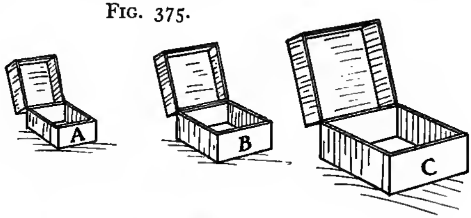


Fig. 376.

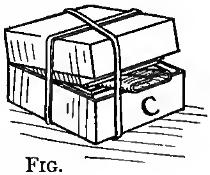


Fig. 377.

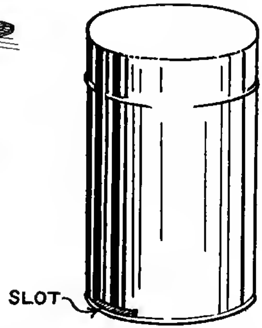


Fig. 374.

Figs. 374–377. — Apparatus for the Marked Coin Trick.

Three pill boxes of graduated sizes, so the smallest will fit inside of the second largest, and the second size will fit inside of the largest, should be obtained for the nest of boxes (*A*, *B*, and *C*, Fig. 375). The covers must be hinged, which is easily done with strips of paper or cloth.

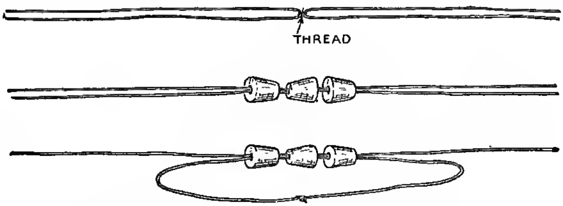
Out of a small piece of tin, bend a flat tube similar to that shown in Fig. 376. Through this tube the coin is slipped into the inside box. Place the tube between the cover and front of each box, and pass a rubber-band around the outside box, each way (Fig. 377). The rubber-bands

will not only keep the tube in place, but will also spring the covers shut as soon as the coin has been passed into the inside box, and the tube has been removed.

Keep the nest of boxes covered with a handkerchief until after you have commanded the coin to pass from the can into the inside box; then, when you remove the handkerchief, it is a simple matter, under cover of it, to slip in the coin and remove the tube.

The Chinese Paradox. This is a very simple trick, yet one of a most mystifying nature when cleverly performed.

FIG. 379.
FIG. 378.
FIG. 380.



FIGS. 378–380. — Details of the Chinese Paradox.

In appearance to the audience, the apparatus consists of three small corks threaded upon two straight pieces of cord (Fig. 378).

First, exhibit the three corks, and two cords 18 inches long. In addition to these cords, you must have two others of equal length, looped as shown in Fig. 379, with the loops tied together with fine thread. These looped cords must be concealed and be substituted for the other cords after they have been exhibited for inspection. Thread the corks upon the looped cords (Fig. 378), and ask two of the audience to take hold of the ends; then have each person hand you one

cord end and keep hold of the other one. Taking the ends handed to you, tie them together as shown in Fig. 380. Then grasp the three corks with one hand and ask the persons holding the ends to pull. At the same time, pass your wand over your hand holding the corks. The thread connecting the cord loops will break when the ends are pulled, and the three corks will be left in your hand, while each person will still retain the cord end that he has been holding. This is the mysterious part of the trick to those concerned in assisting you, as well as to the remainder of the audience.

To Make 14 Coins Increase to 20. In this trick fourteen coins (nickels and pennies will do) are dropped into a plate, each being counted aloud as dropped; then, in order to impress the number of coins upon the minds of the audience, they are picked up one by one, counted, and dropped into a second plate; and a member of the audience is then invited to count them for a third time, placing them back in the first plate. With everybody satisfied as to the number of coins, the magician passes his wand over and around the plate, and declares that the coins have increased to the number of twenty. To prove his

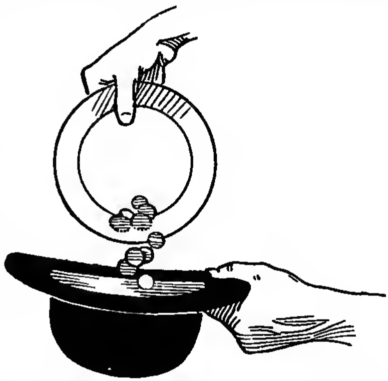


FIG. 381. — Trick: To Make 14 Coins Increase to 20.

statement, he requests one of the audience to bring a hat to the table, and after pouring the coins into the hat, asks that they be counted. To the surprise of all, the owner of the hat actually finds twenty coins.

This is the secret of this interesting trick. On the bottom of the first plate, which is also the last one used, there is a small pocket which contains the extra six coins. The plate should be an old one, because the rim upon the bottom must be cut to make an opening to the pocket. The cutting should be done with a metal-file, and a piece of the rim about 1 inch in length should be removed (Fig. 382). Out of a piece of thick cardboard cut a disk to fit inside of the rim; then from the center of this remove a strip 1 inch wide, and glue the two remaining pieces to the bottom of the plate, as shown in Fig. 383, with the space between left for the pocket. A piece of white paper of as nearly the color of the china as possible should next be fitted inside of the rim, and be pasted to the pieces of cardboard, to form the bottom of the pocket.

Fig. 382.

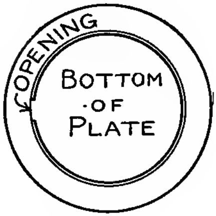
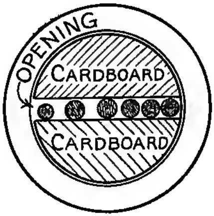


Fig. 383.



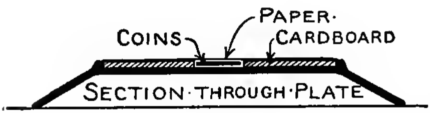


Fig. 384.

Figs. 382–384. — Details of the Plate for Trick: To Make 14 Coins Increase to 20.

Figure 384 shows a sectional view of the plate and pocket.

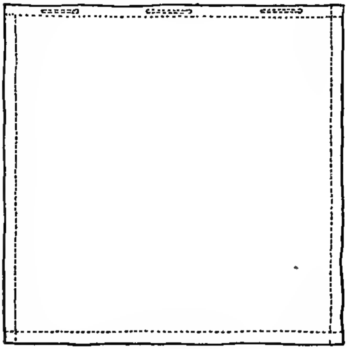
Of course the coins must be slipped into the pocket beforehand, and during the performance of the trick the plate must be held with the open end of the pocket either level or tipped up, until it is time to turn the coins into the hat. It is well to roll up your coat sleeves before exhibiting this trick, so no one will suspect that the coins have been concealed there.

To Break a Match, then Restore It. This trick is not only a good one for a show, but is a capital little stunt to do at a party. In full view of the audience, a match is placed in the center of a handkerchief, the handkerchief is rolled up, and some one is requested to take hold of it and feel that the match is still there. Upon acknowledging that it is, he is instructed to break it, and this he does. There is no question about the match breaking, because the wood is heard to snap, and the person who has snapped it will declare that he felt it snap. But, behold the magician's magic skill! He shakes out the handkerchief, and, to the amazement of all, instead of the match being broken, it drops to the floor in a whole condition.

A previous preparation of the handkerchief is necessary for the trick. The handkerchief should be a common one with a wide hem. Open one hem at one end, as shown in Fig. 386, and slip one or more matches through the opening and along the hem, as indicated by the dotted lines in Fig. 387.

In performing the trick, the method of rolling up the handkerchief after the match has been placed in its center is very important. This must be done in such a way as to conceal the center match in the portion of the handkerchief held nearest yourself, and to bring one of the matches in the hem into position for the person summoned from the audience to break.

This trick can be repeated as many times as you have unbroken matches in the hem, but it is not wise to have



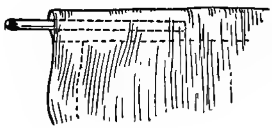


Fig. 386.

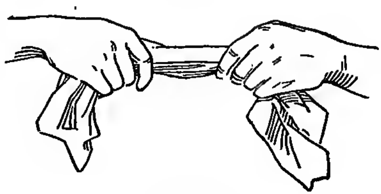


Fig. 387. Fig. 385.

Figs. 385-387. — Details of Trick: To Break a Match, then Restore It.

more than three at the most, because it is difficult to keep track of them and prevent the breaking of the wrong match.

To Transform the Contents of a Glass. After demonstrating to the audience that a drinking glass upon the table before them contains an inky fluid, by dipping pieces of white cardboard into it and showing their blackened sur-

faces upon withdrawing them, the boy magician declares that he will proceed to convert the liquid into water that is as clear as crystal. Whereupon, he throws a napkin or other cloth over the tumbler, makes a few passes over it with his wand, and removes the cloth, exposing to view a glass of clear water.

Besides the glass tumbler, a piece of black rubber large

FIG. 388.

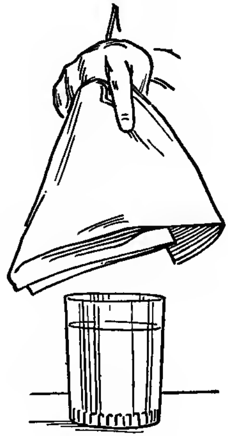


FIG. 389.

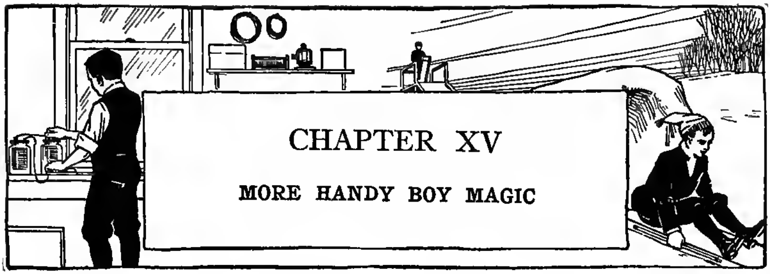
FIGS. 388 and 389. — Details of Trick: To Transform the Contents of a Glass.

enough to fit around the inside is required. To the top edge of this, upon the side farthest from the audience, a piece of fine white silk-thread should be fastened, brought up over the side of the glass, and tied to a small chip of wood (Fig. 388).

Of course the glass is filled with clear water to the height of the top edge of the strip of rubber, and the pieces of

cardboard that are dipped into the water are white upon one side, and black two-thirds of their length on the other side. When dipped into the tumbler, they are held with their white side toward the audience, and then, before being withdrawn, their black side is turned so the audience will see the blackened surface when removed.

When the cloth is lifted from the glass, the chip on the end of the silk-thread is picked up with it, and the piece of black rubber is removed, concealed beneath the cloth (Fig. 389), thus revealing the presence of the clear water. Ask some one among the audience to drink the water to test its purity; then, if all refuse, and it is probable that no one will be willing to take the risk, drink it yourself. This is always a most mystifying trick when cleverly performed.



CHAPTER XV

MORE HANDY BOY MAGIC

THE handy boy magician must accompany his tricks with an interesting line of talk, or *patter* as the magicians call it, to divert the audience's attention as much as possible from his hand movements. Otherwise, they will watch so closely that they may discover the secret of the trick. The talk should contain as many large technical words as you can think of, and it should be laugh provoking because laughter is a splendid means of keeping an audience in the proper spirit to believe what you tell them. A clever talker with a clever line of talk, makes the most successful boy magician. Your patter should be prepared beforehand, and be thoroughly rehearsed with the performance of the trick, so the talking and hand work may be done in unison. Watch your hands as little as possible, while performing a trick, so the audience's attention will not be attracted too closely to them. As you learn your tricks better and better, less attention will have to be paid to your hands.

The Paper-Shower is a trick that has been exhibited with much success during the last few years by a number of magicians, and its simplicity makes it a splendid stunt for the boy magician. In performing this trick, the magician holds up before his audience three pieces of paper of different

colors. Then he tears the paper into strips, folds the strips into a wad, and drops the wad into a fruit-jar containing water. In a minute or two he removes this wad, and taking it in his left hand, picks up a fan in his right hand, and fans the wad, informing the audience as he does this that they will be surprised to see how quickly the wet paper dries. Almost instantly, particles of paper begin to fly out of the left hand, and in a few seconds a shower of fine bits of colored paper flutter in all directions (Fig. 390).

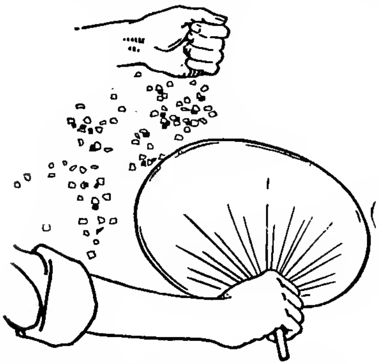


FIG. 390. — The Paper-Shower Trick.

Of course the paper does not come from the soaked paper wad, but from a small sack of *confetti*, or paper bits which you have prepared yourself. This sack must be made of tissue-paper, so as to be easily broken, and it must be pinned to your coat sleeve, directly under the arm-pit of the right arm, in such a manner that it cannot be seen by your audience.

The sack is taken into the left hand in this manner. When you reach down into the fruit-jar to pick up the wad of paper which you have dropped into it, make a pretence of pulling up your right sleeve with your left hand to keep it out of the water, and run your hand far enough up to enable you to take hold of the sack of paper and conceal it in the hand. After squeezing some of the water from the wad

of paper, the wad is supposedly transferred to the left hand, but in reality it remains in the right hand. Quickly pick up the fan from the table, and fan toward the left hand; and squeeze the sack until the tissue-paper bursts and the confetti is exposed to the breeze from the fan. The breeze of course blows the paper away from your hand, but the audience must be impressed with the idea that the purpose of the fan is solely to dry the wet paper, and that you are converting the paper into bits and making these fly, by your magic.

A magical entertainment can be made uproariously funny if the boy magician provides himself with

A Clown Assistant who attempts each trick as soon as he sees it performed. Of course the clown must get everything twisted about, and expose how some tricks are done, else he would not be a clown. Perhaps you will prefer to keep your tricks a mystery, but one or two might be "given away" without hurting your reputation to any marked extent. Not long ago, the author saw a team of vaudeville magicians — one of whom was a clown — perform the *Paper Shower* trick, and the climax to the clown's method of doing it was the funniest thing of the evening. The clown used a pink sporting-section of a newspaper, a colored comic-section, and a white news-section, instead of small pieces of colored paper such as he had seen his magician partner use, and, after tearing these into strips and rolling the strips into an immense wad, he dropped the wad into a pail of water and jumped up and down in the pail to mash the

paper together. Then, taking the dripping wad in his left hand, on which he wore an unusually large glove, and holding a monstrous fan in his right hand, he proceeded to fan. By this time the audience were convulsed with laughter by the clown's funny antics, but imagine the uproar when, after the fanning process had been in progress a few seconds, an avalanche of newspapers suddenly dropped upon the clown. There were wadded papers, folded papers, and rolled papers, and they came from above, from the left, and from the right, until after a few seconds' time the stage was knee-deep with several hundred papers.

Perhaps you could arrange a similar stunt on a small scale for your home magical entertainment, by providing an overhead drop over your stage, behind which to conceal several baskets full of paper, and a rope mechanism for overturning them.

The Hand-Untying Trick. A member of the audience is requested to bind together the magician's wrists, behind his back, with a rope. Then facing that person and the audience, the magician quickly unties his wrists and throws the rope upon the floor.

Figure 391 shows the two wrists bound together, and Fig. 392 shows how one wrist is first tied, and the little trick necessary to make possible the untying feat. Hold your left hand before you while the person ties the rope about the wrist. Then quickly place both hands behind you, make two or three twists in the ends of the rope with your right hand, as shown in Fig. 392, and bring the right

wrist against the knot on the left wrist in such a manner as to conceal the twists in the rope. Then turn your back towards the audience and allow the right wrist to be bound to the left one. Several knots may be tied in the rope, if the person wishes to tie them.

When you turn your back away from the audience again, it is of course only necessary to turn the right wrist

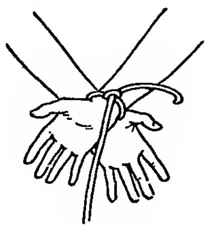


FIG. 391.

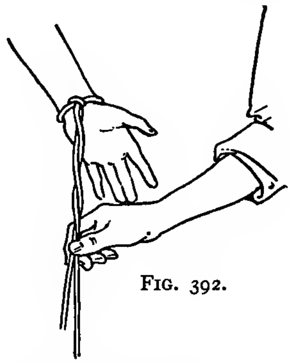


FIG. 392.

FIGS. 391 and 392.—The Hand-Untying Trick.

around so as to undo the twists which you secretly made in the rope; then the loop will be plenty large enough to slip the hand out of it. With the right hand released, it is easy to untie all of the knots and remove the rope from the left hand.

This hand-untying stunt is often employed in

The Cabinet Trick, where a person, bound hands and feet, is placed inside of a cabinet. The door is closed, and then, when opened a few minutes later, the bound person is discovered entirely freed from his bonds.

A variation of the trick that is even more mystifying to the audience is carried out in this way. The magician binds his assistant, and after seating him in the cabinet, places various musical instruments around him. When the cabinet has been closed, the musical instruments begin to play, yet when the cabinet is opened a minute later, the assistant is still seated, with hands and feet bound together just as he was when placed there. Of course, in this case, the man slips his right hand out of the loop, then uses both hands to play the musical instruments, and replaces his hand in the loop before the magician reopens the door.

These cabinet hand-untying tricks can easily be carried out by the boy magician, after training an assistant to do the hand-untying stunt. A cabinet framework can be constructed out of strips 1 inch thick and 2 inches wide, and this can be covered with pieces of carpet, or any cloth that you can find. The usual scheme is to support the cabinet upon standards so the audience can see beneath it. You might use a piano-bench, or a couple of boxes for your support.

Turning Paper into Coffee. This is not as difficult as might be imagined. In fact it is very simple magic. Two baking-powder cans of equal size, a cover small enough to set into the top of one can, a napkin or towel, and an empty hat-box filled with cut paper, are the necessary pieces of apparatus. Trim about 1/4 inch from the edge of the can cover, with the exception of two little flaps which should be

bent out sideways as shown in Fig. 394. The purpose of the flaps is to support the cover in an inverted position upon the rim of one of the cans.

Before the performance, fill one of the baking-powder cans with hot coffee, set the cover in the top, fill the cover with the cut paper (Fig. 395), and conceal the can inside of the box of cut paper. All is then ready.

To begin this feat of turning the paper into coffee, pass the empty can among the audience for inspection, then, stepping back to your table on which the box of cut paper has been placed, hold the can down in the box, and scoop up several handfuls of cut paper and drop it into the can. But instead of removing this can from the box, after filling it, lift out the can containing the coffee. As the inverted cover placed in the top of this can is filled with paper, no one will suspect the substitution. Cover the napkin over the can, and announce that the transformation from paper to coffee is about to take place; then pass your magic wand over the top, and lift off the napkin, removing with it the inverted cover by catching hold of the ends of

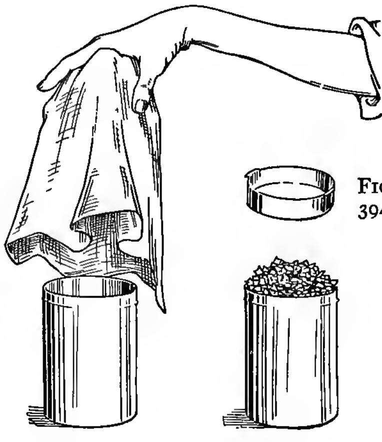


Fig. 394. Fig. 393. Fig. 395.

Figs. 393–395.—Details of Trick: Turning Paper into Coffee.

the projecting tabs. If the coffee has not been allowed to stand too long, it will still be hot, and you might pour out a little in a cup and pass it to some one in the audience to sample.

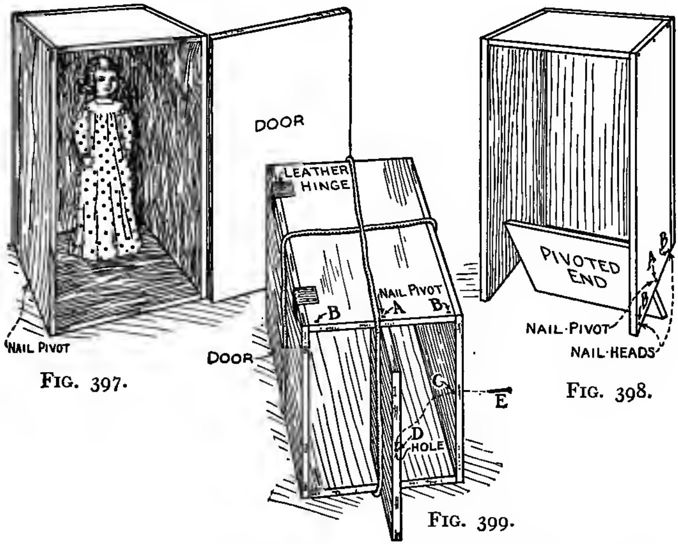
The Disappearing-Doll Trick (Fig. 396) is a simplified form of one of the often performed cabinet tricks. It is extremely simple for a handy boy to carry out, and will always mystify an audience.

FIG. 396. — The Disappearing-Doll Trick.

In the professional act, the magician places a woman inside of a cabinet that stands upon a table, after first having exposed all sides of the cabinet to the view of the audience; then he closes the front, binds the cabinet lengthwise and crosswise with rope, and places it inside of a sack, which he ties. Then, after the use of his wand, and the utterance of some words of magic, he reverses his operations, removes the cabinet from the sack, places it back on its standard, cuts the ropes, and opens the front. And behold! the lady occupant has vanished, and the cabinet is empty.

You will understand this trick when I explain the disappearing doll stunt, which is carried out similarly, but on a smaller scale.

The Cabinet is shown completed in Fig. 397. This should be made out of a box about 6 inches deep, 7 inches wide, and 11 inches long. Remove one end of the box, being careful not to split it in doing so, and pivot it between the



FIGS. 397–399. — Details of Cabinet for the Disappearing-Doll Trick.

sides as shown at *A* (Figs. 398 and 399), driving a brad through each side into the center of each end edge. This piece must be placed carefully so it will swing up into its former position in the end of the box, without showing any indication of being pivoted. A nail-head should be driven

in, each side of pivot-nail *A*, as at *B* (Figs. 398 and 399), to give the appearance of a solidly fastened end. It may be necessary to plane off a trifle of the back edge of the end piece to make it turn easily. To provide for locking the end so it will not turn, make a small hole through the back of the box (*C*, Fig. 399), and in the back edge of the end piece (*D*), and push a small brad into these holes for a *locking pin* (*E*). Hinge the cover to the box with strips of leather, and the constructive part of the work will be finished.

The Doll used in the trick must have a small enough head and body to slip through the rear opening in the end of the cabinet. Line the inside of the cabinet with cloth of a bright color, gathering it around the edge, and stuffing in a little cotton or cloth underneath to give it a soft, padded appearance.

The boy magician needs an assistant for this trick, who must be concealed either underneath a table, by means of a drapery fastened around the legs, or in

A Packing-Box Table constructed similar to that shown in Fig. 396. The illustration shows how the legs, fastened to the ends of the box, raise the box about 6 inches above the stage floor.

Performing the Doll Trick. The cabinet must be turned around so the audience may inspect all sides, then the doll should be placed within, the cover closed, and the cabinet tied with heavy cord. Upon the tying of this cord much of the success of the trick depends, for with a cord passed

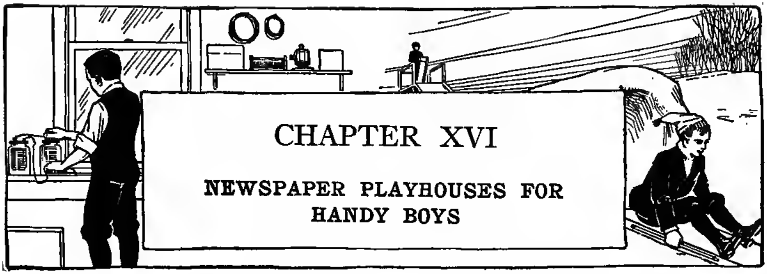
around the box both lengthwise and crosswise, it will appear to the audience impossible for any portion of the box to open. However, you will see by Fig. 399 that the pivoted end opens very easily when the cord tied lengthwise of the cabinet comes just to one side of the center of that end.

While passing the twine around the sides and ends, the cabinet should be kept near the center of the table. If a cloth has been spread over the table, the audience can plainly see that there is no possibility for the doll to disappear through a trap-door in the table. When both ends of the cord have been brought around to the top, the cabinet can be rested upon the edge of the table without arousing any suspicion, for all have seen the cord passed around the six sides. This is the time for the assistant to act quickly. He must reach out from his position inside the table (Fig. 396), withdraw the locking pin *E* (Fig. 399), turn the pivoted end of the cabinet, remove the doll, and then close and lock the pivoted end. In the professional trick, the occupant of the cabinet escapes similarly through a trap-door in the stage floor, after the cabinet has been tied up and stood upon the floor.

The cabinet should now be placed inside of a small bag, the wand passed around it, and a few magic words spoken; then it should be taken from the bag, untied, and the empty interior exposed to the view of the audience.

After making the doll disappear, you can bring it back into the cabinet, by having the assistant replace it in the

same way that he removed it, while the magician is tying the cord around it; and by preparing two cabinets, it is a simple trick to make the doll pass from one cabinet to the other, and back again.



CHAPTER XVI

NEWSPAPER PLAYHOUSES FOR HANDY BOYS

INDOOR playhouses may be built without driving a single nail, by using newspapers instead of wood, as has been done in the construction of the log-cabin and Indian tepees illustrated in this chapter. No doubt you handy boys who are accustomed to making almost everything out of wood or metal will be surprised to know that newspapers can be used for this work; but when I tell you that the paper is coated with flour paste, and then rolled into tubes, or "logs," you will understand how easily the results are obtained.

Newspapers accumulate rapidly, and you will not have to wait long to collect a large enough supply for the building material. Besides the papers, you will need a pail of paste and a brush with which to spread the paste. A brush 3 inches wide is about right.

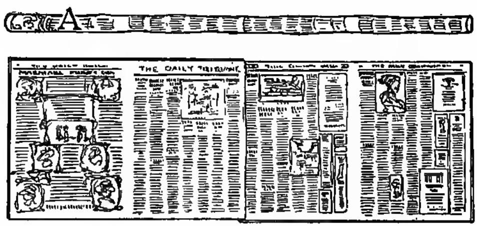


FIG. 402. — The Full-Length Logs A.

The Log-Cabin illustrated in Fig. 400 requires the use of four different lengths of logs, and these are shown in the diagrams of Figs. 402, 403, 404, and 405. You will see by

these diagrams that the full-length logs *A* (Fig. 402) are the length of two sheets of paper, with the edge of one lapped about 1 inch over the edge of the other, that the three-quarter length logs *B* (Fig. 403) are one full sheet and one half-sheet in length, that the half-length logs *C* (Fig. 404) are one full sheet in length, and the quarter-length logs *D* (Fig. 405) are one half-sheet in length.

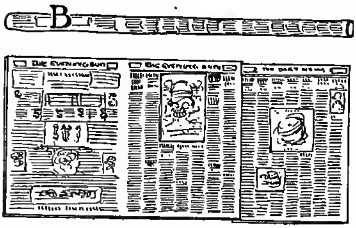


Fig. 403. — The Three-Quarter Length Logs B.

To Prepare a Paper Log, — one of the *A* logs, for example (Fig. 402), — lap and paste the edges of two sheets of newspaper together as shown in Fig. 402, then cover these with a coat of paste, lay two other sheets exactly over them, and coat them with paste. Then, starting at one edge, turn the paper over upon itself from end to end, and roll it up into a tube. The tubes will flatten on account of being soaked with paste, but by rolling them back and forth it will be easy to round out these flattened portions. Place the tubes upon a flat surface to dry, so they will remain straight and not become bow-

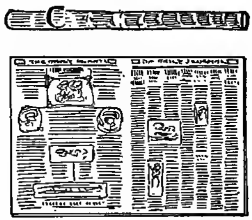


Fig. 404. — The Half-Length Logs C.

Fig. 405. — The Quarter-Length Logs D.

FIG. 400.—A NEWSPAPER LOG-CABIN.

FIG. 401.—BUILDINO THE WALLS OF THE LOG-CABIN.
(Showing how Upright Paper Logs support the Corners.)

shaped. Do not use any of them until they are thoroughly dry, through and through.

All of the tubes should be made of two thicknesses of paper, and in case any of them show signs of bending along the newspaper folds, reenforce them at those points with bands of paper. The logs for the cabin should be about

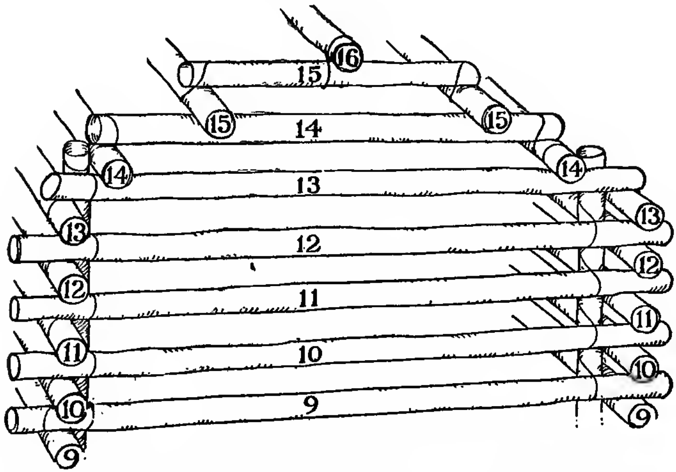


FIG. 406. — How the Logs are Connected at the Corners with String.

3 inches in diameter, while the "sticks" for the *chimney* should vary from 3 inches to about 1½ inches in diameter.

Building the Cabin Walls. First place a front and a rear log upon the floor, then cross them 6 or 8 inches from the ends with a pair of end logs. This will give the ground lay-out of the cabin. Each side of the *entrance*, and at the four *corners*, a paper *upright*, or "post" must be placed, to support the logs at those points, and to add stiffness

to the cabin walls. To hold these posts in position until the walls have been built up to the point shown in Fig. 401, it will be necessary to place a chair or stool against each. The logs should be fastened to the corner posts with string (Fig. 406), and to the entrance posts with rubber-bands (Fig. 407), or with string. The eleventh front log forms the head of the doorway, and the thirteenth tier forms the top of the side walls (Figs. 400 and 406).

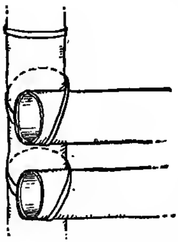


FIG. 407.—How the Cabin Logs are Fastened to the Entrance Posts with Rubber-Bands.

The Roof Framework. When you have placed the thirteenth tier of end logs in position (Fig. 406), set the next tier of side logs (No. 14, Fig. 406) inside of the tops of the corner posts. Then cut off end logs No. 14 so they will just extend from one side log No. 14 to the opposite one. Set side logs No. 15 about 12 inches nearer the center than the side logs No. 14. Cut off end logs No. 15 to reach from one side log No. 15 to the other, fasten them to these side logs as shown, and place log No. 16 across their centers. This last log crosses the center of the cabin, lengthwise, and forms the *ridge-pole* of the roof framework.

The cabin roof is completed by spreading sheets of newspaper across the log framework. These may be fastened in place with pins or with paste.

The Stick Chimney is simpler to build than the cabin walls. It may be constructed at the same time as the cabin (Fig. 401), or it may be built afterwards. The illus-

FIG. 408.—A PLAY INDIAN VILLAGE WITH NEWSPAPER TEPEES AND KETTLE TRIPOD.

trations show clearly how the sticks are crossed, how the lower portion (to a height of about 2 feet) is made with thick logs, and how the upper portion is built with thinner ones set a few inches inside of the lower logs. The top of the chimney should extend about 8 inches above the cabin roof.

Some of the logs which were used to build the cabin may be taken for making

Tepees for an Indian Village (Fig. 408), or, if you have a large playroom, and wish to keep the cabin intact, you

FIG. 410.

FIG. 411.

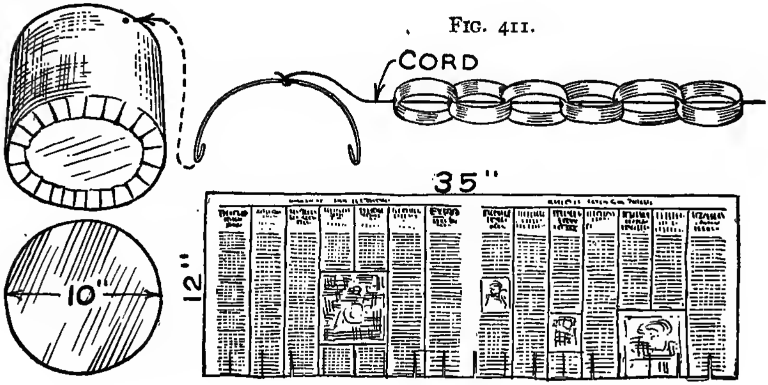


FIG. 409.

FIG. 409. — Diagram of the Kettle Sides and Bottom Pieces.
FIG. 410. — Paste the Side Flaps to the Bottom like this.
FIG. 411. — The Wire Handle and Paper-and-String Chain.

may make extra "poles" for the tepees. The cabin and the tepees would afford lots of fun if you have brothers and sisters to play with, or when neighboring children

come in to visit you, because you could then play pioneering, with a pioneer settlement and the Indian village.

Figure 408 shows how thin tubes are stuck into the ends of the paper poles used for the tepee framework, and how these are crossed. Tie the upper ends together, and spread the lower ends as shown; then either pin or paste newspapers around the poles for a covering.

A Kettle Tripod for your Indian village, or for your cabin camp, like the one in Fig. 408, is formed by fastening together three paper poles at the top in the same manner that the tepee framework is put together, and

The Kettle is made as shown in Figs. 409 to 411. The *sides* of the kettle are made of two sheets of newspaper folded in half, as shown in the diagram (Fig. 409), with the lower edge slashed for a distance of 2 inches; and the *bottom* is made of two circular pieces of cardboard 10 inches in diameter (Fig. 410). Bend up the pieces between the slashes of the sides, to form *flaps*, then bend the sides around one of the bottom pieces, lap and paste them together, and paste the flaps to the cardboard (Fig. 410). Paste the second bottom piece over the under side of the flaps, to conceal them.

Make the *handle* out of a piece of wire, bending the ends as shown in Fig. 411 so they will hook into holes punched in the sides of the kettle.

Suspend the kettle from its tripod by means of a paper *chain* (Fig. 408). Probably you have made similar paper chains, but this one must be reenforced by threading the

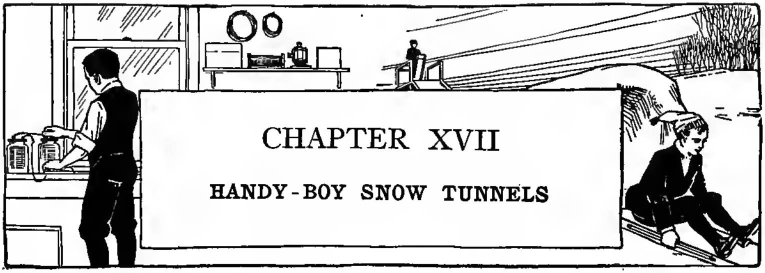
paper links on to a piece of cord, as shown in Fig. 411, because the chain in itself would not be stiff enough to support the weight of the kettle. Tie one end of the cord to the kettle handle, and the other end to the top of the tripod.

The Make-Believe Camp-Fire is built of small tubes of the size of those used for the cabin chimney.

There are many

Other Things which can be Built with Paper Tubes, including *forts*, *summer-houses*, *rail-fences*, and *doll-swings*, and the tubes may be set up on end for *telegraph-poles* for a play *telegraph system*, or for *trees* for a play *forest*. Other ideas will suggest themselves while you are playing.

After the logs have once been prepared, they will last indefinitely, because they are easily repaired if broken, by pasting bands of paper around the broken places.



CHAPTER XVII

HANDY-BOY SNOW TUNNELS

THIS new coasting idea is easy to carry out, and you will find tunnel coasting one of the greatest of winter sports, just as have thousands of the author's readers for whom

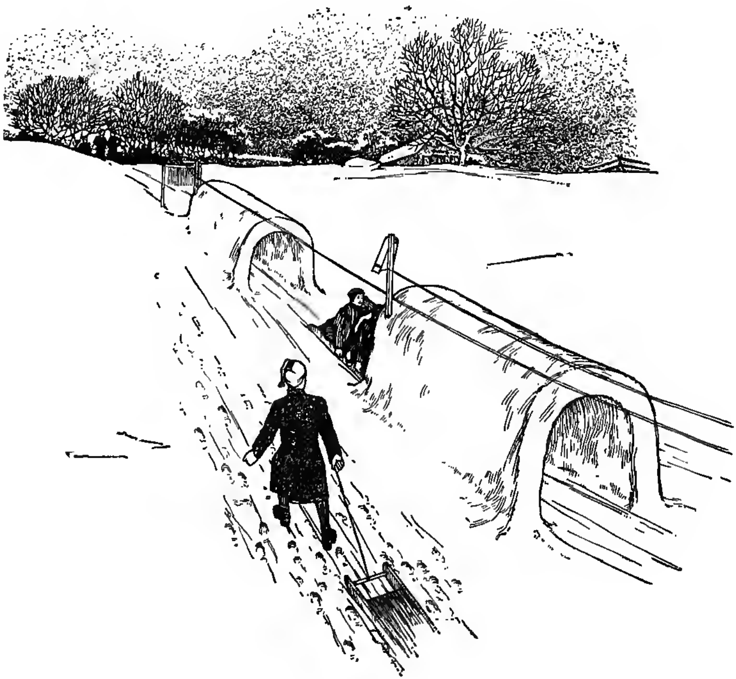


FIG. 412. — If you Coast Down a Hill, Build Several Tunnels Along the Slope.

he originally invented the idea and published the plans in The Ladies' Home Journal. One boy can build a tunnel unaided, but two boys can complete it much quicker of course, and there is always more fun building one with somebody to work with you.

If you coast down a hill with a long slope, build several tunnels along the slide as shown in Fig. 412, or if you own

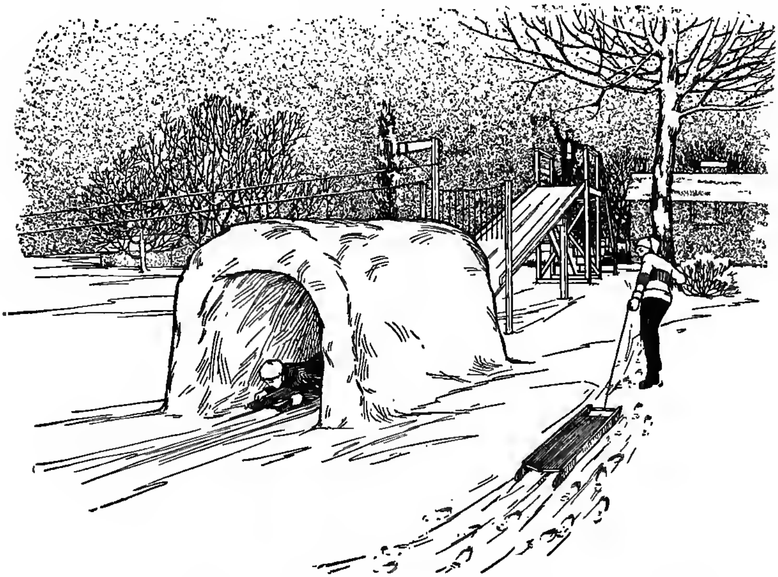


FIG. 413. — If you Own a Toboggan-Slide Build a Tunnel at the Foot of It.

a toboggan-slide, build a tunnel at the foot of it as shown in Fig. 413.

The tunnels may be built in the ordinary way of making snow-houses, but they are much more substantial if you

Construct a Framework similar to that shown in Fig. 414 to support the roofs. This will prevent the roofs from collapsing when the snow begins to melt.

The framework consists of two side frames (*A* and *B*, Fig. 414), with boards laid across the tops. The frames may be made indoors, then carried out to the spot upon

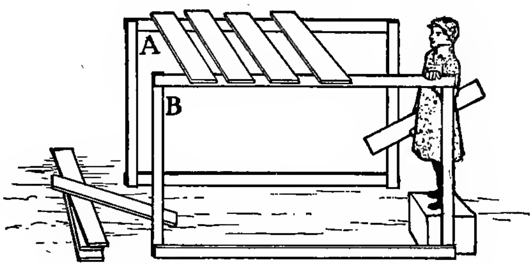


FIG. 414. — The Framework for the Snow Tunnel.

which you are going to build the tunnel, set up in position, and banked around the base with snow to hold them in place.

The roof or ceiling should be 12 inches above your head, when you are seated upon your sled within the tunnel, which will make the height above ground between 4 feet 6 inches and 5 feet; take this into consideration in making the side frames.

Build the Tunnel Walls about 12 inches thick, and pile plenty of snow upon the roof boards so a rounded roof can be made. Not only round off the top of the roof, but arch the ceiling as well, as shown in the sectional view of the tunnel (Fig. 415).

If the Snow is Soft Enough to Pack, roll it into large balls, and roll the balls over to the site for the tunnel; there they may be chopped up for building material. This simplifies the matter of transporting the snow.

Make Deep Tracks in the snow, throughout the entire length of the tunnel, of the proper gauge for your sled run-

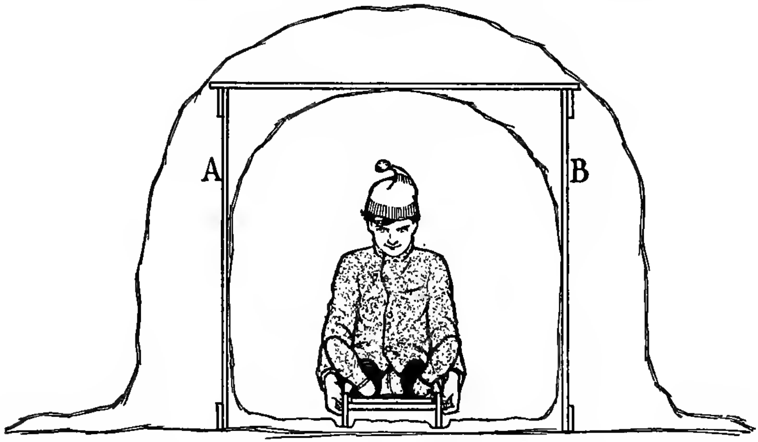


FIG. 415. — A Sectional View of the Snow Tunnel.

ners, and bank the snow at either side of the entrance to guide the sleds into the tracks.

To regulate the coasting so one boy will not collide with another, it is best to

Install a Semaphore Signal System. In Fig. 412 the semaphore shown at the entrance to the tunnel which the boys are just entering is set at "Safety," and in Fig. 413 the semaphore at the entrance to the tunnel through which the boy is passing is set at "Stop." The semaphores are

operated by each coaster as he reaches the foot of the slide, being first set at "Safety," to signal the next boy to start from the top, and then changed to "Stop" as soon as they are passed. Each coaster should remain at the end of the slide long enough to set the signals for the coaster following him.

Figures 416 and 417 show

The Construction of the Semaphores. Cut the arm *A* 20 inches long, and taper it from 4 inches wide at one end to 3 inches wide at the other end, and cut the *spectacle* piece *B* 10 inches long, and of the shape shown in Fig. 417. Nail *B* to *A*, then bolt it to upright *C*, running the bolt through *B* as shown, with washers placed between the head of the bolt and *B*, between *B* and *C*, and between *C* and the nut. Tighten the nut just enough so the arm will stand in a horizontal position until pulled down by the cord attached to its end. Upright *C* should be fastened to the wooden framework of the tun-

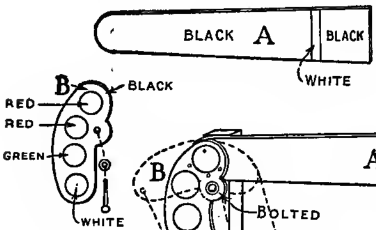


FIG. 417.

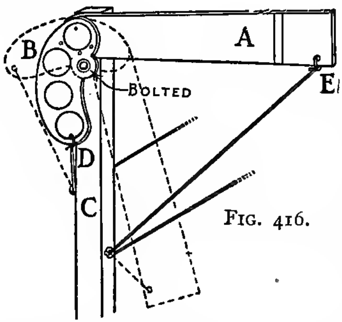


FIG. 416.

FIG. 416. — The Semaphore Set at "Stop." (Dotted lines indicate Position of Arm when dropped to "Safety.")

FIG. 417. — Detail of Arm and Spectacle.

nel, and should be of the right length so arm *A* will swing clear of the snow roof.

Fasten a cord through a hole in *A*, at *E*, and another through a hole in *B*, at *D*, and run these cords through two screw-eyes in *C;* then carry the cords to the end of the coasting slide.

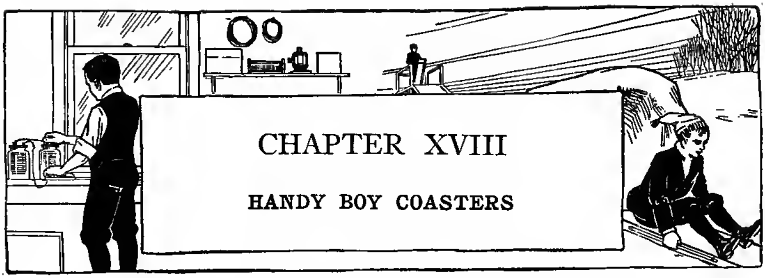
Paint the arm of the semaphore black with a white band near the end, and the spectacle frame black with the two upper *spectacle glasses* indicated by red, the next below by green, and the bottom one by white.

To make your sled "railroad" as complete as possible, you must place

A Telltale a few feet in front of your tunnel entrance, as shown in Fig. 413. One of these you know is hung in front of every low railroad bridge or tunnel to warn the brakemen stationed upon the tops of freight-cars to duck their heads.

To make the telltale, stretch a rope between two uprights, and tie a number of pieces of rope about 24 inches in length to it so their ends will be just low enough to brush against the heads of the coasters as they pass under them.

For Coasting after Dark, you may make *lanterns* out of starch-boxes, or other small boxes, and set one upon the top of each tunnel. These may be candle lanterns similar to the Signal Telegraph lantern shown in Fig. 528, page 336, with a piece of glass covered with red tissue-paper set in the fronts. You may also make headlights for your sleds.



CHAPTER XVIII

HANDY BOY COASTERS

A HANDY boy can build himself a coaster that will be just as good as a bought one, and as the material required amounts to so little, the expense connected with the construction is trifling. Perhaps just the right sort of lumber will be found in the basement or woodshed, and in that case no outlay whatever will be necessary. Almost any kind of wood will do, but straight-grained pieces are easiest to work up, and the fewer knots, cracks, and other defects that there are the better. Of course putty and paint will conceal nail-holes and small cracks, but do not depend too

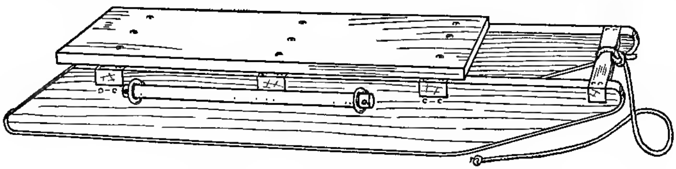


FIG. 418. — The Double-Runner Coaster.

much upon "putty magic," because putty shrinks when it hardens, and in a wide crack this shrinkage is enough to make an ugly hollow place in the surface of your work.

The Double-Runner Coaster shown in Fig. 418 is of just the proportions that the average boy finds to his liking — 4 feet long and 14 inches wide, with runners 5½ inches

deep. This is a substantially constructed sled and is practical for all around purposes.

A pattern for

The Sled Runners is shown in Fig. 419. Lay off the given measurements upon a piece of 2-by-6 with pencil and carpenter's square — or a yard-stick. Most 2-by-6-inch material is about 5¾ inches wide, though it often runs a trifle under or a trifle over this. Whatever the measure-

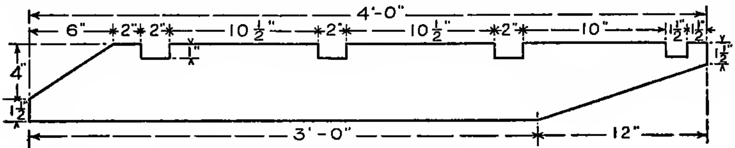
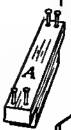


FIG. 419 — Pattern for Runners.



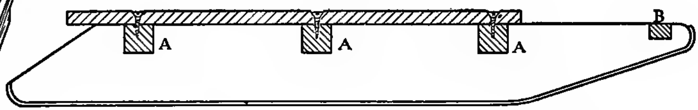


FIG. 420. — Cross-Brace.

FIG. 421. — Longitudinal Section through the Double-Runner Coaster.

ment is, you can vary the width of your runners accordingly. The notches along the top edge receive the ends of the connecting *cross-braces* (*A*, Figs. 420 and 421), and the *foot-bar B*. After checking your measurements, to be certain that no mistakes have been made, saw off the ends square; then saw off on the diagonals of the bow and stern ends. When you have completed one runner, mark out the other with it as a pattern.

Cut the Connecting Cross Braces *A* 14 inches long, 2

inches wide, and 2 inches thick, and cut the *tongues* on their ends to fit the notches in the runners. Nail the braces to the runners, and also drive nails through the side face of each runner into their ends, as shown in Fig. 418.

The Sled Seat should be a piece of board 12 inches wide and 2 feet 8 inches long. The ends of this are shown square in the illustration, but they may be curved or cut off upon the diagonal if you wish to take the extra time to prepare them that way. Screw or nail the seat to the cross braces.

FIG. 422. — Coasting on a Single-Runner Coaster.

The Handle-Bars are two pieces of broom-handle, and their ends are held by screw-eyes screwed into the sides of the runners. Drive a nail through each end of each handle-bar into the runner, to keep it from slipping out of the screw-eyes.

You can improve the sliding qualities of the runners by greasing them; but at a small expenditure you can **Provide the Runners with Shoes** of *hoop-iron* or of *half-oval iron* strips, which will be more satisfactory. The iron strips can be purchased at almost any large hardware store.

They must be bent to fit the ends of the runners, and be drilled for the screws with which they are to be fastened in place. You can get this done at a blacksmith's shop, or at a machine-shop. Hoop-iron is easy to put on, because it can be bent by hand, and holes for nails and screws can be punched through it with a nail. The iron binding strips

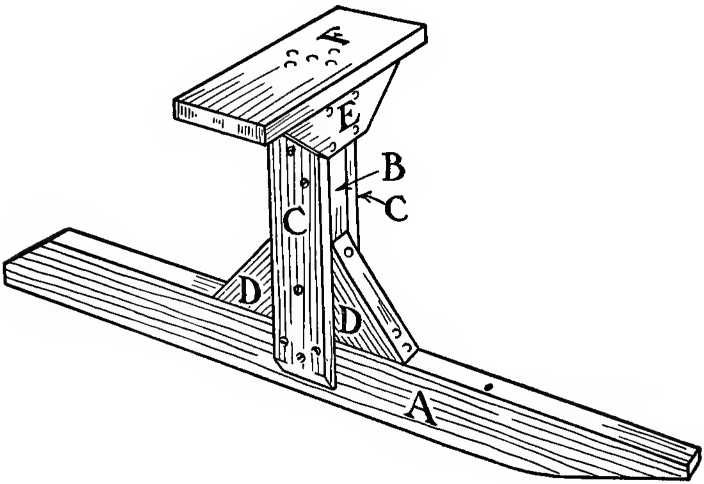


FIG. 423. — Detail of the Single-Runner Coaster.

with which large packing-cases are bound can be used, also, for runner shoes.

It requires skill to coast with

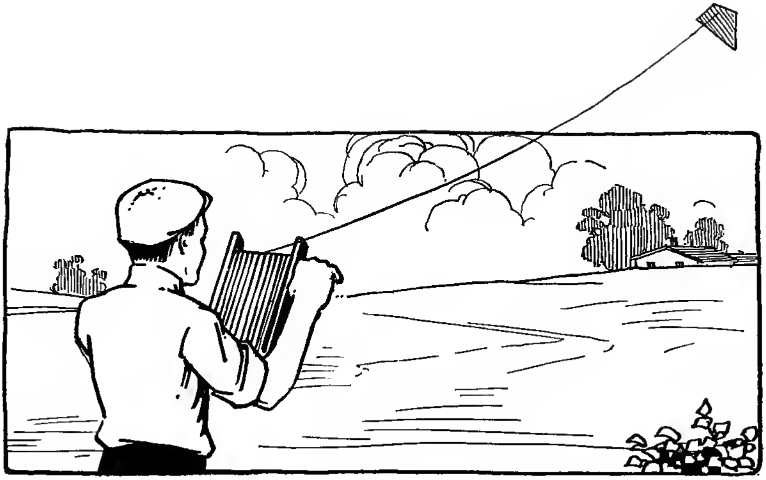
The Single-Runner Coaster (Fig. 422), and that is one reason why this unique form of sled is so popular with boys who have once learned to use it. Any boy can become expert in handling one after getting the knack of balancing himself.

Figure 423 shows a detailed drawing of the completed single-runner coaster. Make

The Runner *A* 3 feet long out of a piece of 2-by-4, and cut the upright *B* out of the same material 13 inches long, and spike the bottom of *B* to the top edge of *A*, 6 inches back of the center of its length. The side pieces *C* are 4 inches wide and 16 inches long, and, together with the triangular blocks *D*, strengthen the connection between *A* and *B*.

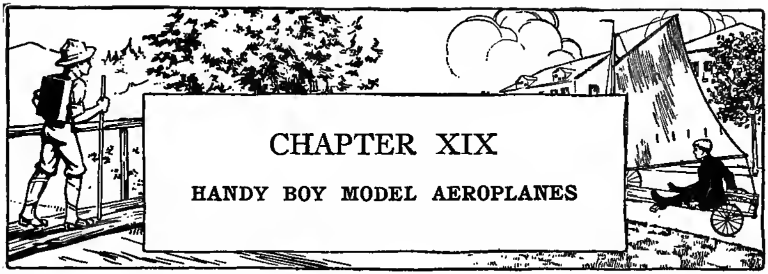
The Seat Board *F* is 15 inches long and 6 inches wide, and is nailed to the top of post *B*. Brace the seat with two wooden brackets nailed across post *B*, front and back.

Runner Shoes may be prepared in the same manner as those described for the double-runner.



PART II

Spring and Summer Pastimes



CHAPTER XIX

HANDY BOY MODEL AEROPLANES

Model aeroplane designing, building, and flying is the latest of boys' pastimes, and no scientific diversion has ever received greater support. It is obviously a handy boy's sport, a sport for the boy of a mechanical turn of mind with inventive genius. There is no room in junior aeronautics for idlers, or for aero enthusiasts who are merely fascinated with anything that flies. Store models painted in bright colors are best for this sort of chaps, and will probably outlast their burst of enthusiasm. But the boy with practical ideas of his own, the boy whose interest in model aeroplanes is genuine, will have nothing but models of his own planning and making, leaving the store variety to the "would-be" model aviators who have been seized with a passing fancy. It is interesting to note that each model which has made a record for itself has been the product of its flier, both as regards its design and construction, and that no two records have been attained by models of similar form. Thousands of designs have been evolved during the short interval of time since the innovation of model aeronautics, and the developments have been quite

as startling as those obtained by the man-carrying machines. Indeed, for the same space of time, the development of the model has far surpassed that of the large machine, and the bird-man has even had the opportunity to learn a pointer or two from junior model designers.

Every successful inventor is a thorough investigator of what has been accomplished along a line of work before taking it up, in order that he may know what to do and what not to do, and that is just the way in which model aeroplane construction has advanced. Each successful designer has profited not only by his own mistakes, but by those of others as well, and by borrowing the good points of other machines, and adding improvements, he has been able to turn out a model having a greater degree of perfection. There has been no patenting of ideas to retard the progress of model aeroplane construction.

The first model designs followed the lines of the various forms of monoplanes, biplanes, and multiplanes, but the results of time have shown that the most successful models, the models having the greatest stability, attaining the greatest speed, and making the longest flights, are those of the monoplane type. All of the starting, duration, and distance records have been made with this type of model, and the other types have been abandoned almost entirely. Another radical change that has come about has been the placing of the propellers at the rear of the fuselage or body, instead of at the front, which was at first considered the better arrangement, and instead of having a single propeller,

most machines are now equipped with twin propellers and twin motors. To reduce the weight of models to a minimum, the tendency has also been to eliminate all show effects, and all features that are not essential for strength and stability. Even the skids are being omitted from models that do not rise from the ground, to lessen weight and reduce air friction.

One interesting result of the developments of the past two years is that, while models have been made more and more efficient fliers, their construction has become more and more simple. Thus, the models of two years ago which were considered remarkable if they flew 300 feet or so, were of more complicated construction than models which are now flying 2,500 feet and over. Think of it, boys, one of these later models of simpler form, the "Pelican No. 2," built by Percy Pierce of the Philadelphia Model Aero Club, recently made a world's record of 2,733 feet, or 93 feet farther than one-half mile, and an unofficial record of something over 3,000 feet, while the duration record at the present writing is 91 seconds. The chances are that these records will not stand long, with a continuation of the present activity in model making, which has made it necessary for the author to revise the above figures twice while preparing this chapter.

The Materials now used in model aeroplane construction are about the same as those out of which the first models were built. The *fuselage, motor base*, or body framework, is generally constructed of pine or other soft wood, or of

bamboo, carpenter's dowel sticks, or aluminum. The *planes* are sometimes made of very thin wood or aluminum, but are more generally built up, having frames of wood, split bamboo, aluminum wire, or piano wire, covered with silk, bamboo fiber paper, or other light-weight stiff paper, and coated with varnish, shellac or banana-oil. Aluminum wire is generally used for *stays*, on account of its light weight. The cloth covering material is sewed to the plane frame-work with strong linen thread or silk thread, and the paper is fastened with glue. All joints of the fuselage and plane frames are bound with strong thread, and then the thread is coated with glue to hold it in place.

The *propellers* are generally cut out of wood, though sometimes they are made of aluminum. Propellers can be purchased ready for mounting, or in *blank* form ready for cutting. The expert model builder, however, prefers to design and prepare his own propellers from start to finish. Straight-grained white pine is the best wood to cut propellers out of. The *propeller-shafts* are made of piano wire, or other stiff wire, and the *bearings* of *tin* or *brass*.

Rubber-bands, joined end to end by looping one through the other, have been used for *motors*, as have also the rubber strands from old golf-balls, but flat rubber strands of single length, such as are sold for the purpose by dealers in model aeroplane supplies, are infinitely better and generally used.

Each of the three models for which working-drawings are given in this chapter, has been a prize winner, and all are good examples for the beginner to pattern after, because

they typify the latest ideas in model aeroplane construction. As you will see by the photographs of Figs. 424 to 427, the monoplane type of model now in vogue is a modified form of the Blériot machine, turned stern foremost, with the smaller plane in front, and with twin propellers at the rear.

The Wells Model Aeroplane, shown in the photographs of Figs. 426 and 427, and detailed in the working-drawings of

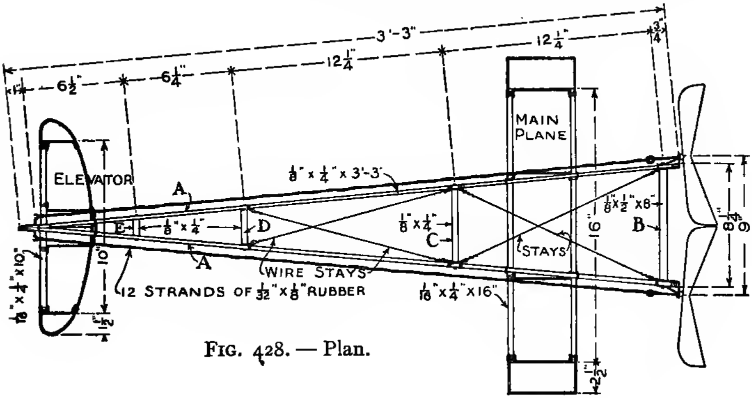


FIG. 428. — Plan.

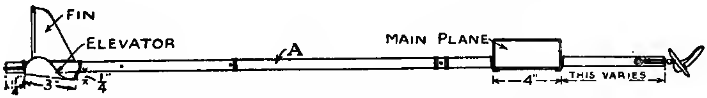


FIG. 429. — Side Elevation (without Rubber Motor).

FIGS. 428 and 429. — Working-Drawings of the Wells Model Aeroplane Designed and Built by Harry Wells (See also Figs. 426 and 427).

This Model has a record of 1620 feet made at the Aero Club of Illinois' Aviation Field at Cicero, Chicago.

Figs. 428 to 436, is an excellent model designed and built by Harry Wells of Chicago, and won the 1912 season's silver cup trophy awarded by the Illinois Model Aero Club. It has a distance record of 1,620 feet, made at the Aero

Club of Illinois' aviation field at Cicero, Chicago, where it flew 16 feet beyond the fence of the 160 acre field. The model weighs but 5½ ounces, has 9-inch propellers of 27 inch pitch, and is in every essential a speed machine.

The first part of the model to make is the triangular

Fuselage, or *motor base*. This consists of two side sticks, *splines*, or *spars* (*A*, Fig. 428) of straight-grained white pine cut to the dimensions marked upon the drawing, with their bow ends beveled off for a distance of 1¼ inches, glued together, and bound with thread. The stern ends have a spread of 8 inches, and are braced at that distance by the *separator B* (Fig. 428). This separator is fastened flatwise between sticks *A*, and its edges are reduced as shown in the small section drawing of Fig. 430 so they will offer less resistance to the air. This piece is fastened between sticks *A* with brads. Separators *C*, *D*, and *E* are of the sizes marked in Fig. 428, and of the proper length to fit between side sticks *A* at the places indicated on the drawing. They are cut oval-shaped as shown in the small section drawing in Fig. 430.

Before fastening the separators in position,

The Thrust Bearings for the propellers, and the *end plates* for connecting the wire *stays*, must be prepared. Figure 431 shows a dimensioned detail of the thrust bearings, and Fig. 430 shows how they are bound to the ends of sticks *A* with thread. These are cut out of brass, bent into the shape shown, and have a hole pierced through the folded tip for the propeller-shaft to run through, another

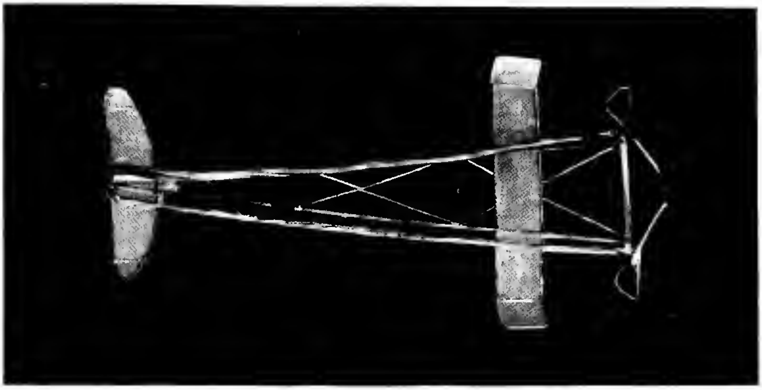


Fig. 426.—The Wells Model Aeroplane.

Fig. 427.—Harry Wells launching his model, also a view of his back-yard workshop.

through one end for the brad to pass through that pins stick *A* to *B*, and another through the other end to fasten the end of the wire stays to. The small detail in Fig. 430 shows the end plates for the wire stays. These are made no longer than is necessary for the connecting holes for the wire-stay ends. Pierce a hole through the center of each plate for the brad to pass through which fastens sticks *A*

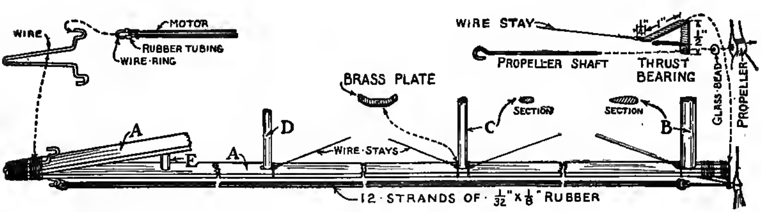


FIG. 430.

FIG. 430. — Detail of Fuselage and Motor of the Wells Model.
FIG. 431. — Detail of Thrust Bearing, Propeller-Shaft, and Connections.
FIG. 432. — Detail of Bow Hook and how Rubber Motor is Connected to it.

to the ends of the separators. The plates are bound to sticks *A* with thread.

The Bow Hooks support the bow ends of the rubber motor, and are made upon the ends of a piece of heavy piano-wire bent V-shaped to fit over the ends of sticks *A* (Fig. 432). Bind the wire to the sticks with thread, coating the thread with glue to make it hold fast (Fig. 430).

The Main Plane has a framework built as shown in Fig. 433, with the front or *entering-edge*, and the rear or *following-edge*, made of sticks of white pine or other light-weight wood, and the *ribs* and *tips* on the ends made of No. 16 gauge

aluminum wire. The ends of the frame sticks are cut away on their outer edge, to receive the ends of the wire forming the tips, and the ends of these wires, and the laps of the wire ribs, are bound in position with thread, and the thread then coated with glue to hold it in position.

The Elevator, or front plane, has a framework made as shown in Fig. 434. Its entering-edge is a stick, and its following-edge, ribs, and end tips, are made of No. 16 gauge aluminum wire. You will notice by Fig. 434 that the

FIG. 434. FIG. 435.

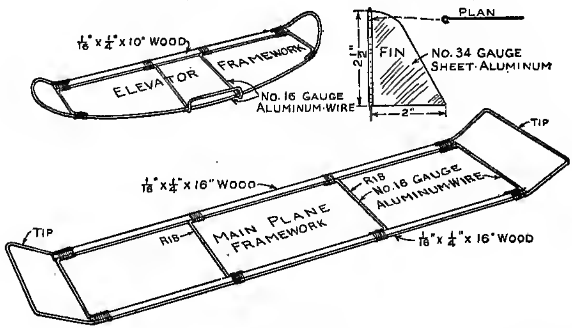


FIG. 433.

FIG. 433. — Detail of the Main Plane Framework of the Wells Model.
Fig. 434. — Detail of the Elevator Framework.
FIG. 435. — Detail of Fin.

center ribs cross the following-edge of the frame and are bent up in the form of a flat loop. This loop rests against the under side of the fuselage, and gives the elevator its proper angle for stability (Fig. 429). The tips are bent up to add stability.

The frames of the main plane and elevator are covered

with china-silk, which may either be sewed or glued in place, and this is given a thin coat of shellac to make it air-tight and taut. The covering must be put on smoothly to reduce to a minimum what is known as *skin resistance* — the resistance that the plane makes to the air while passing through it.

The main plane and elevator are held to the fuselage by means of rubber-bands slipped beneath them and over the fuselage, and unlike the planes of the majority of models, are fastened to the under side of the fuselage. Figure 429 shows the approximate position of the elevator. That of the main plane will vary under different air conditions, sometimes being placed over the separator *C*, and at other times closer to separator *B* than is shown in Fig. 428. Therefore, you must adjust your plane and elevator — this operation is known as *tuning* — to suit the condition of the atmosphere, until you find the positions where they will give the machine the greatest stability. A great factor in the successful flight of a model aeroplane lies in properly tuning the planes, both laterally and longitudinally, and of course the planes must balance at their centers, in order to make the machine balance properly.

The Fin directly over the center of the elevator (Figs. 427 and 429) is provided for stability, and may be used as a rudder by turning it slightly to one side or the other. It is made of No. 34 gauge sheet aluminum, cut to the form shown in Fig. 435. Its vertical edge is bent around a piece of heavy wire, as shown in the plan detail of Fig. 435, and

the lower end of the wire is fastened upright between the bow ends of sticks *A*.

The Propellers are the most difficult part of the model aeroplane to make. They must be very accurately cut, and must be of identical size and *pitch*. The pitch of a propeller is, theoretically, the distance forward that it advances in one complete revolution.

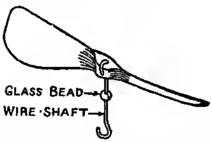


FIG. 436. — The Wells Model Propeller.

Figure 436 shows one of the propellers of Harry Wells' machine, which is 9 inches in length and has a 27-inch pitch. Figure 437 shows

How to Prepare the Propellers. The pair must be opposites, that is, one must be of right-hand pitch and the other of left-hand pitch, or, in other words, the upper end of the right-hand pitch propeller turns to the right, and that of

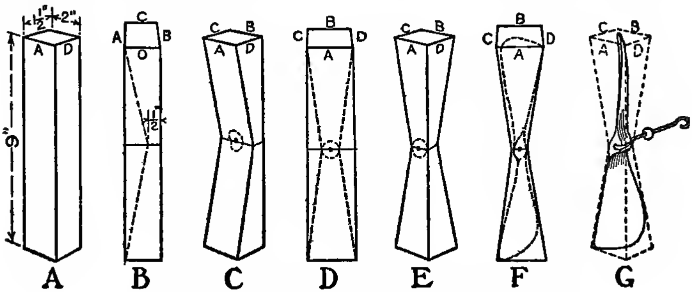


FIG. 437. — How to Prepare a 9-inch Propeller.

the left-hand pitch propeller turns to the left, when viewing them from the rear.

Step *A* consists in properly planing up a straight-grained block of white pine 1½ inches thick, 2 inches wide, and

9 inches long, with its sides and ends straight and true, for

The Propeller Blank. Draw a line around the four faces of this block at the exact center of the length. Then on faces *C* and *D*, lay off a distance of ½ inch on the center-line, measuring from the edge of face *B*, for the thickness of the propeller-hub, and draw diagonal lines from the upper and lower left-hand corners of faces *C* and *D* to the end of the hub center-line (Step *B*). Then cut away the portions outside of these lines, as shown in Step *C*. Lay out the hub upon faces *A* and *B* of the block, with a ½-inch diameter, and bore a small hole through the center to receive the propeller-shaft (Step *C*). Draw diagonals from the corners to the center-line of the hub (Step *D*); then cut away the wood outside of these lines (Step *E*).

The next step (*F*) consists in laying out the form of the propeller blade upon all four sides and ends of the block, and Step *G* is the final one of cutting out the propeller, scooping out its blades concave on one side, and carving them convex on the opposite side. A very sharp knife must be used for cutting; and the work must be done slowly and carefully, because the least slip is likely to ruin the propeller. The *entering-edge* of each blade is the almost straight edge, and should be cut very thin. The ends of the blades should also be cut thin, while the hub should be cut away as much as can safely be done without weakening the propeller.

When you have completed cutting the propellers, place

them at their centers across the edge of a knife-blade, and if they do not balance perfectly, locate the trouble and correct it. Finish the work with fine emery-paper, and then shellac it. Some boys glue silk over the ends of their propeller blades, for a distance of ½ inch or so, to reenforce them and make them less likely to split.

The Propeller-Shafts are made of heavy piano-wire, bent into a hook at one end (Fig. 431) to receive the rubber strands of the motor, and cut of the right length to extend through the hole in the bearing, through a glass bead, through the propeller, and then to bend over the side of the hub (Figs. 430 and 431). By bending over the end of the shaft against the hub, it is held securely in place.

The Motors consist of twelve strands of ⅛-inch flat rubber, each, and as these are 1 yard in length, exactly 24 yards of rubber are required. The rubber is not connected direct to the hooks on the bow and propeller-shafts, as the wire would quickly cut through the strands. Instead, small rings are bent out of wire, with pieces of small rubber-tubing slipped over the wire, and the ends of the rubber strands are looped through these rings and bound in place with thread (Fig. 432). The wire rings are then slipped on and off the hooks quickly. As light and heat cause rubber to deteriorate, you must remove the motors from the machine after use, pack away in a covered box, and keep in a cool place, in order to get the longest life possible out of the rubber.

It has been found that rubber motors can be wound

much farther by lubricating them with glycerine. It is only necessary to put a few drops of the glycerine upon a clean cloth, and rub it over the outside strands; then wind the motors, and it will work over the surface of the inner strands until all parts are covered.

Of course the rubber motors must be twisted an equal number of turns, in order to make the propellers work the same, and this is usually done with an ingenious winder made from an egg-beater, which winds both motors simultaneously. This home-made winder is shown in Figs. 448 and 451, and described upon page 284.

The Nealy Model Aeroplane shown in Figs. 438 and 448 is the design of Arthur Nealy of Western Springs, Illinois, and has a flight record of 1,550 feet, and an endurance record of close to 1½ minutes, made in contests of the Illinois Model Aero Club. This model has shorter propellers of lower pitch than those used on the Wells machine, and is what is generally known as a *floating model*, as it has great stability, and depends a great deal upon the air in back of it to float it.

The Fuselage is of the triangular form of the Wells model. Side sticks *A* are ¼ inch thick, ¼ inch wide, and 34 inches long, and the separators *B* and *C* are bamboo strips 1-16 inch thick, and ¼ and 3-16 inch wide, respectively. Instead of being fastened between the side sticks with brads, the ends of these separators are tapered very thin and slipped into slits cut through side sticks *A;* then the sticks are wrapped tightly with thread, each side of the

separators, to keep the frame intact (Fig. 439). The slits must be cut very carefully so as not to split the sticks. The

FIG. 440.
FIG. 441.
FIG. 442.

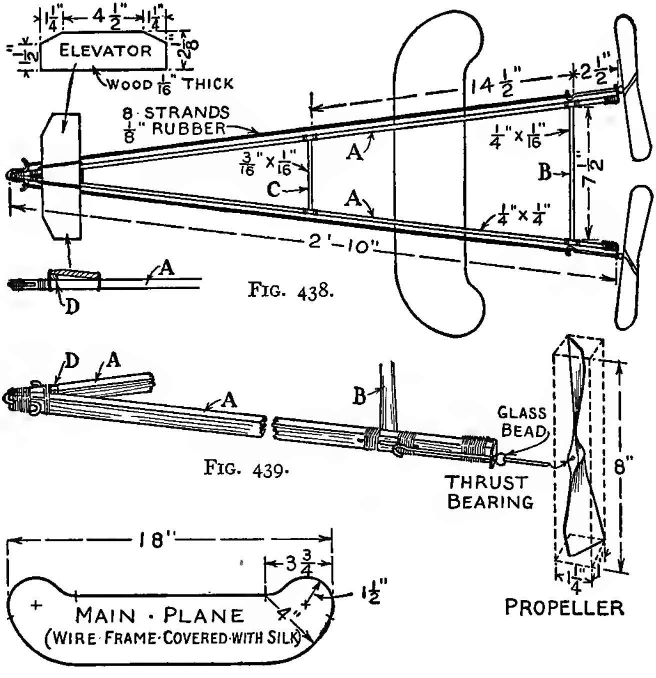


FIG. 443.

FIG. 438. — The Nealy Model, Designed and Built by Arthur Nealy, of Western Springs, Illinois. Distance Record, 1,550 Feet.
FIG. 439. — Detail of Fuselage.
FIG. 440. — Detail of Elevator.
FIG. 441. — How the Elevator is Tilted.
FIG. 442. — Detail of Main Plane.
FIG. 443. — Detail of Propellers.

bow ends of sticks *A* are beveled off upon the inner faces so they will fit together, and are glued. Then the wire

hooks which hold the bow end of the rubber motors are prepared on a V-shaped piece of wire, and are bound to the bow end with thread (Fig. 439).

The Thrust Bearings are made of strips of brass bent L-shaped, and are bound to the ends of sticks *A* (Fig. 439).

The Elevator is made of a piece of wood 1-16 inch thick. A piece of wood veneer may be used. Figure 440 shows a pattern for cutting it. The front or entering-edge of the elevator is slightly tilted, by being supported on top of the square peg *D* (Figs. 439 and 441), which is fastened between sticks *A*. The elevator is held in place on top of the fuselage by a rubber-band slipped over its ends and over sticks *A*.

The Main Plane has a built-up framework of No. 16 gauge piano-wire (Fig. 442). The ends of the wire are lapped and bound together in the same manner as in the construction of the Wells machine. The frame is covered with china-silk. This may either be sewed in place or glued. It is first fastened to one end of the frame, then stretched lengthwise tight enough to bow or *flex* the frame, and fastened to the opposite end. Then it is stretched sidewise and fastened to the sides of the frame. This gives the ends of the plane a slight *camber* which aids in securing greater stability than can be had with a flat plane. A slight upward bending of the tips of the plane will give the model additional stability. The main plane is held to the under side of the fuselage by rubber-bands.

The Propellers are cut from blocks 1 inch thick, 1¼ inches wide, and 8 inches long (Fig. 443). Prepare them in the

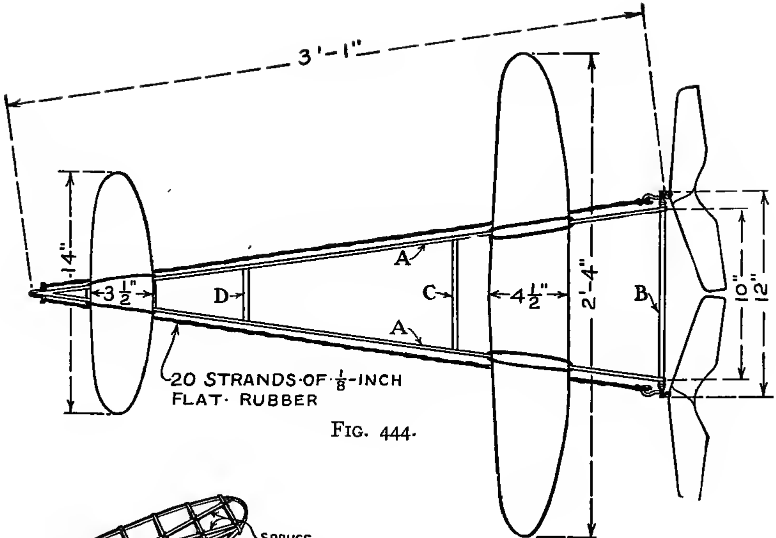


FIG. 444.

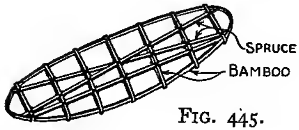
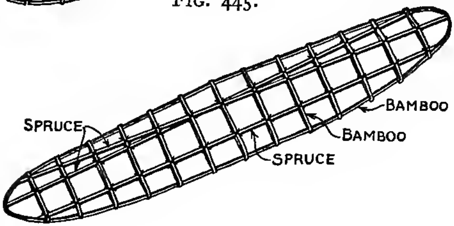


FIG. 445.



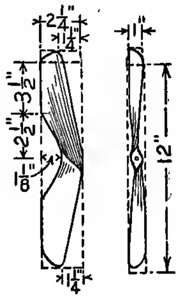


FIG. 446. FIG. 447.

FIG. 444. — The Selley Model, Designed and Built by Armour Selley of Brooklyn, N. Y. Distance Record, 2,653 feet.

FIG. 445. — Detail of Elevator Framework.

FIG. 446. — Detail of Main Plane Framework.

FIG. 447. — Details of Propeller.

same manner as described for the Wells model, and illustrated in Fig. 436. Be sure to get the blades of equal but opposite pitch, and to make them balance nicely.

The Propeller-Shafts are made of piano-wire, with a hook on one end to receive the rubber strands of the motor. A glass bead is slipped on to the opposite end between the propeller and the bearing plate. The propeller end of the shaft is bent over the side of the hub, to keep the propeller from turning on the shaft.

The Rubber Motors consist of 8 strands of 1/8-inch flat rubber, each.

The Selley Model Aeroplane shown in Fig. 444, and designed by Armour Selley of Brooklyn, New York, caused a great deal of astonishment in model aeroplane circles when it made the remarkable distance of 2,653 feet, or 13 feet better than 1/2 mile, during the summer of 1912, in a contest held by the Long Island Model Aero Club. It is radically different in many respects from the Wells and Nealy models, and, in fact, from most of the other machines in use at the time of the present writing.

The Fuselage is triangular in shape, with side sticks of spruce cut 37 inches long, beveled and glued together at the bow, and braced with three separators between the bow and the stern.

The Planes have built-up frameworks of split bamboo and spruce strips, as shown in Figs. 445 and 446. The edges of the planes are made of bamboo, as are also the ribs; and the horizontal strips crossing the ribs are slender spruce

sticks. The details show how two of the horizontal sticks of each plane cross one another, and also how the ribs are doubled around the edge sticks, and are bound with thread at each intersection with the other members of the framework. The dimensions of the planes are shown upon the plan (Fig. 444). The frameworks are covered on each side with bamboo fiber paper, which is glued in place, and this covering is then given a coat of thin shellac or banana-oil to make it shrink tight and thus reduce the skin resistance. The planes are held to the upper side of the fuselage by means of rubber-bands.

The Propellers of this machine are its most remarkable feature, being 12 inches in length and having a pitch of 14 feet, while the motors consist of 20 strands of rubber. Thus, this model is a machine of very great power and high speed. Figure 447 shows two views of one of the propellers, with the dimensions for the *blank*, and for laying out the shape of the propeller. The detail of the thrust bearing, though slightly different from that of the two machines previously described, may be similar to that of either, and the rubber strands of the motors are connected to the wire hooks in the same way as those of the other machines.

Figures 448 to 451 show photographs of some interesting forms of model aeroplanes. In Fig. 448 Arthur Nealy of the Illinois Model Aero Club is shown launching the model of which the working-drawings are shown upon a preceding page, and Figs. 449 to 451 show three models designed and built by Percy Pierce, member of the Philadelphia Model

FIG. 448.—ARTHUR NEALY LAUNCHING HIS MODEL.

FIG. 449.—PERCY PIERCE'S "PELICAN NO. 2." RECORD FLIGHT 2,733 FEET.

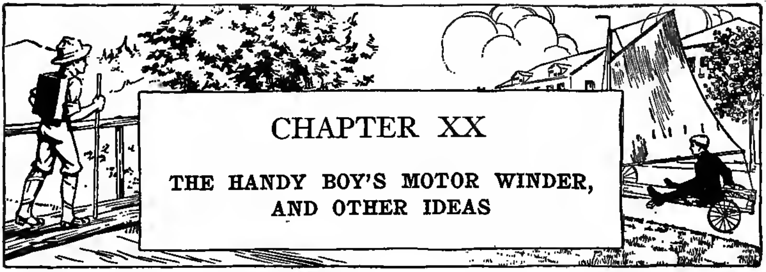
FIG. 450. — PERCY PIERCE'S INCLOSED BI-PLANE MODEL.

FIG. 451.—PERCY PIERCE'S "HYDRO NO. 6," RISING FROM THE WATER.

Aero Club and the New York Model Aero Club. From the beginning of model aeronautics, Percy Pierce has been one of the most active of workers, and no other designer has nearly as many records to his credit, nor devised as many successful models. Several Percy Pierce models are upon the market, and they are recognized generally as the most efficient of ready-built models. The Pierce "Pelican No. 2," shown in flight in Fig. 449, broke the World's distance record on September 21st, 1912 with a flight of 2,733 feet, or 93 feet farther than one-half mile; the inclosed biplane model shown in Fig. 450 has been one of the most successful machines of the biplane type; and the Pierce "Hydro Model No. 6," shown rising from the water's surface in Fig. 451, has a distance record of over 900 feet, figured from the point of rising.

At the present writing,

The Hydro-aeroplane is the latest thing in model making, and it is by far the cleverest model yet devised. The machine itself does not differ in form from the monoplane models shown upon preceding pages. It is equipped with a running-gear made of bamboo, and to the lower ends of this pontoons are attached, on which it skims along the water's surface. The pontoons are usually three in number, and they have frames of cardboard or bamboo, covered with paper, and then coated with varnish to make them impervious to water. The best of the hydro-aeroplane models arise from the water after they have traveled eight or ten feet.



CHAPTER XX

THE HANDY BOY'S MOTOR WINDER, AND OTHER IDEAS

The majority of boys wind the rubber-strand motors of their model aeroplanes with ingeniously contrived winders made from egg-beaters. With one of these winders, both motors can be wound simultaneously, and the advantage of this is apparent when it is known that rubber-strand motors are wound one-thousand turns or more for each flight, and that the number of turns of one must be exactly the same as that of the other. This would be a long, tedious operation by hand, and then, too, there would be the possibility of a mistake now and then in the count of the number of turns made in one motor or the other.

The Egg-Beater Winder shown in the photograph of Fig. 452 is the one which Harry Wells of the Illinois Model Aero Club has devised. It is very simple to make, as you will see by examining the detail drawing of Fig. 455. In this drawing, the dotted lines represent the original form of the revolving loop ends of the beater. It is only necessary to cut off these loops, and the central pivot wires on which the loops turn, and bend the cut-off ends of the loops into hooks. The loop ends that cross the central pivot-wire ends must be punched for the wire ends to stick through, and

Fig. 454.—The Wells distance measuring device.

Fig. 452—An egg-beater motor winder.

Fig. 453.—Winding the rubber-strand motor with the egg-beater winder.

the ends of the wires must be riveted to keep the hooks in position.

Figure 453 shows

How the Egg-Beater Winds the Motors. While an assistant supports the model by the propeller end, you remove the motor rings from the hooks on the bow of the fuselage, and slip them on to the hooks of the egg-beater. Then you turn the crank of the winder, counting the turns as you do so, and when you have wound the motors as far as you wish, you slip off the motor rings, and slip them back again on to the bow hooks of the model aeroplane.

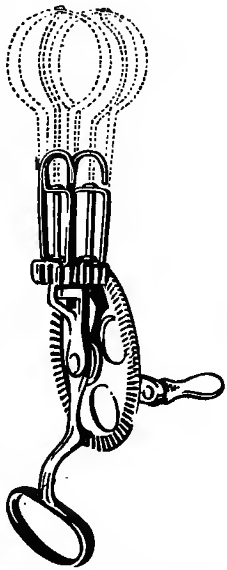


FIG. 455.—Detail of Egg-Beater Motor Winder shown in Fig. 452.

Wind the Motors Slowly, especially after the first row of knots begin to form, as it puts the rubber to the least amount of strain by doing this. Quick winding not only strains the rubber, but makes the knots form in bunches, and uneven winding, of course, produces uneven unwinding.

As I have mentioned before, it is possible to wind the motors much farther, and thus to store up a greater amount of motor energy, if the rubber strands are lubricated with glycerine. The motors should be wound just before the machine's flight, in order not to keep the rubber under a strain longer than

is necessary. Take the best possible care of your motors, removing them from the model after use, and packing them away in a closed box to keep them out of the light, and you will get the greatest efficiency possible out of the rubber.

The propellers must be held after the motors have been wound, to keep them in check. Figures 424 and 427 show

The Position to Take for Launching a Model from the hand. The machine should not be thrown forward, as the movement would cause too great a disturbance of the air, resulting in the machine losing its stability, and probably upsetting. The best method is to give the model a slight push that will start it off at a speed a trifle under that produced by its propellers.

The distance of flights is measured in various ways by the officials of the several model aero clubs, but the ingenious device used by the Illinois club, and the invention of Harry Wells, whose prize-winning model and home-made egg-beater winder I have shown you, is the most practical instrument for the purpose yet devised, combining as it does ease and quickness of operation. Figure 454 shows

The Wells Distance Measuring Instrument in use by its inventor, while Figs. 456 to 464 show working-drawings of its construction, and Fig. 465 shows a diagram of how a measurement is taken with it. You will notice that the instrument consists of a *graduated stick*, having a metal *slide* on top that contains *hair-lines*, and a *sight plate* on one

end. The graduated stick is pivoted to the top of a tripod for support.

The Graduated Stick (*A*, Fig. 456) is 3 feet 4 inches long,

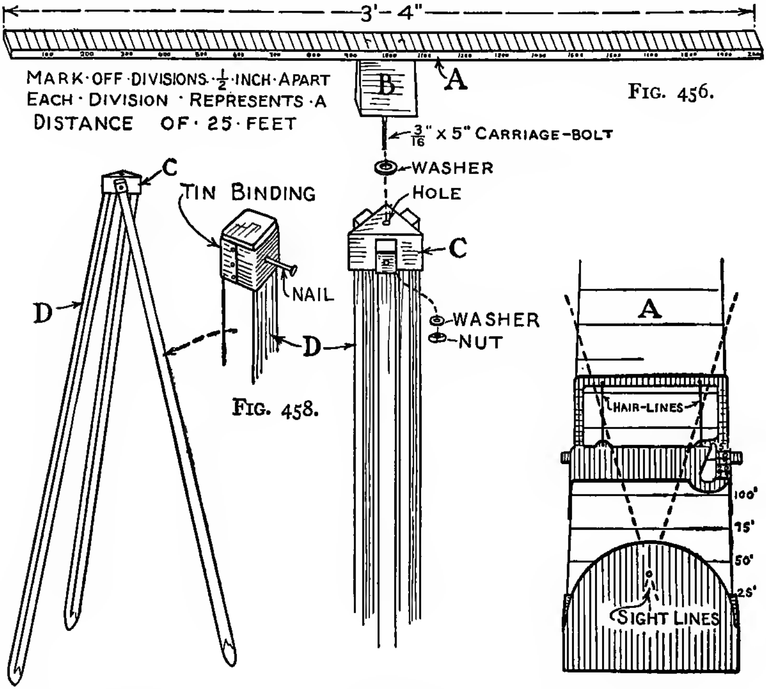


FIG. 456.

FIG. 458.

FIG. 457. FIG. 459. FIG. 460.

FIG. 456. — The Graduated Stick of the Wells Distance-Measuring Device Shown in Fig. 454.

FIGS. 457–459. — Details of the Tripod.

FIG. 460. — End of Graduated Stick, with Sight Plate and Hair-Line Slide in Position.

1½ inches wide, and ⅜ inch thick, and is divided off into 80 parts, each ½ inch in length, by lines drawn horizon-

tally across the stick. Each of the divisions represents a measurement of 25 feet, and at every 100 feet the measurement is marked off upon the edge of the stick, as indicated, for convenience in reading.

A camera tripod may be used to support the graduated stick, but.

The Tripod used for the Wells instrument is simple to make if you haven't one (Fig. 457). The top plate *C* is a triangular block 2 inches thick, and 4 inches long on each side, and the legs are sticks 4 feet 6 inches long, and are pivoted to the side of top plate *C* with nails. The upper end of each leg is bound with tin (Fig. 458) to prevent the nail pivots from splitting the legs. Figure 459 shows how the legs are folded for transporting the tripod. The lower end of each leg is tapered to a point, to make the tripod stand solidly.

A 3-16-inch hole is bored through plate *C*, to receive a 3-16-inch by 5-inch carriage-bolt, and the block *B*, which is 3 inches square, is bolted to the tripod plate *C* by means of this bolt. After slipping the bolt through a hole bored through plate *C*, nail the graduated stick, at its exact center, to the top (Fig. 456). Place washers between *B* and *C*, and between *C* and the bolt nut, so the graduated stick will turn readily.

The Sight Plate, which fits on one end of the graduated stick (Fig. 460), is cut out of brass. Figure 461 shows the pattern for cutting, and Fig. 462 shows how the ends are bent to form slides to fit the end of the stick. The hole for

the *sight* is made in the exact center of the width of the plate, and is pierced with a very fine brad because it must be very small.

The Hair-Line Slide (Fig. 460) is also made of brass. Figure 463 shows the pattern for cutting and folding this.

FIG. 461.

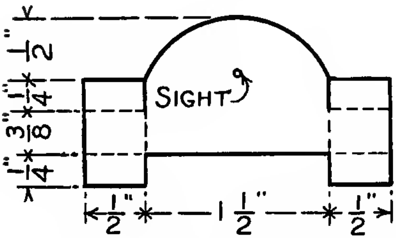
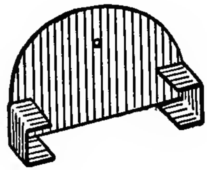


FIG. 462.



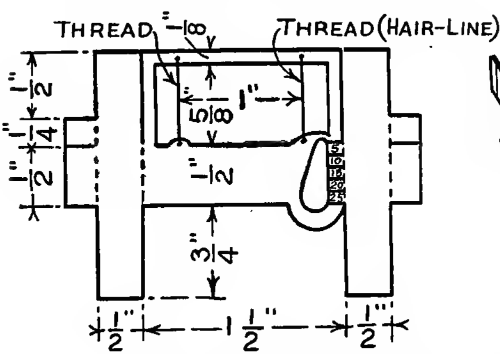


FIG. 463.

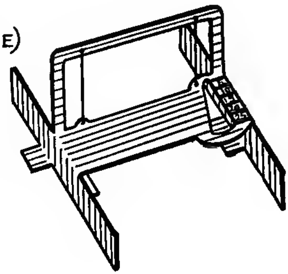


FIG. 464.

FIGS. 461 and 462. — Details of Sight Plate.
FIGS. 463 and 464. — Details of Hair-Line Slide.

Cut along the solid lines, and fold along the dotted lines. Figure 464 shows the completed slide. You will notice that one half of the tips shown upon the ends of the pattern

(Fig. 463) turn under, to slide along the under side of the graduated stick, and that the other half bend out for tips to catch hold of in sliding the slide back and forth along the graduated stick.

The hair-lines are pieces of black linen-thread, and are fastened through pin-holes pierced through the rim of the upright frame. These hair-lines must be exactly vertical, exactly 1 inch apart, and in the exact center of the frame.

The flat part of the slide is ½ inch long (Fig. 463), and is divided off at the right-hand side into five equal parts; and you will notice that an opening is made through the slide directly to the left of these graduations. The spaces between the graduations represent 5 feet, each, and as the slide slides along the graduated stick, these smaller graduations divide up the 25-foot graduations on the stick into 5-foot divisions, just as the ¼-inch divisions on a ruler divide up its 1-inch divisions. The small graduations are used for determining measurements which come in between the graduations on the stick.

Two sticks with a piece of cloth tacked to each, for

Flags, connected near their bottom ends with a rope of the proper length to space them exactly 50 feet apart, are required in addition to the measuring instrument.

To Take a Measurement with the instrument, two officials of the meet must follow the model aeroplane, and drive the ends of the two flags into the ground on a line with the model's landing position (Fig. 465). The connecting rope

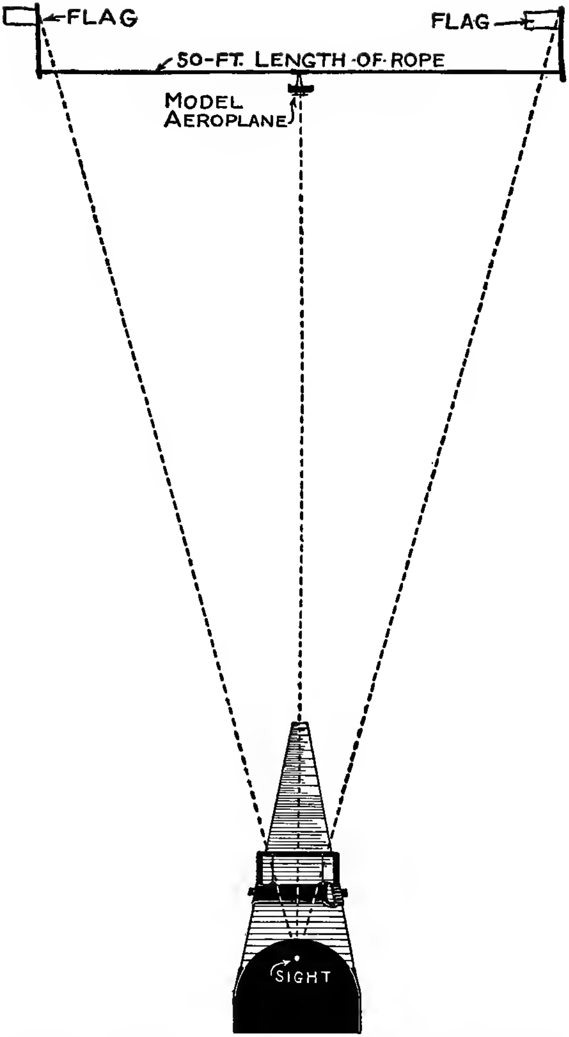


FIG. 465. — Diagram Showing how the Distances of Model Flights are Determined by the Wells Distance-Measuring Device.

should be stretched taut so the flags will be exactly 50 feet apart.

The measuring official should then sight through the sight plate on the end of the graduated stick of the instrument (Fig. 465), and slide the hair-line slide back and forth along the stick until the hair-lines coincide with the flag-sticks, or, in other words, until the sight hole, the hair-lines, and the flag-sticks are in straight lines, as indicated by dotted lines in Fig. 465. Now, when the slide has been so adjusted, the reading at the front end of the slide will show the measurement of the distance of your model aeroplane from the starting point. If the slide is not set on a division line of the graduated stick, take the next division mark back of it, and add to this the additional number of feet shown upon the small scale on the slide.

To test the accuracy of readings taken with this measuring device at a distance of 1,500 feet, the distance was measured off with a 100-foot tape, and a difference of less than 4 inches was found, part of which was no doubt due to sagging of the tape.

Model Aeroplane Contests have become a part of the large aviation meets, and have excited almost as much admiration among the spectators as the larger man-carrying machines. The model machine has also taken a place among moving-picture attractions, and the launching and landing of these little machines are now to be seen at moving-picture shows.

Every city of any importance has its model aero club,

and many public spirited business men are donating trophies for each season's model tournaments.

The following

Rules for Governing Model Contests have been selected from those prepared by the New York Aero Club and the Aero Club of the West Side Department of the New York Young Men's Christian Association, and present the essential requirements for a model meet:

1. The officials shall be a Starter, Measurer, Judge, and Scorer; also three or four Guards to keep the starting point and course clear. The first three named officials shall act as a Board of Judges in settling all questions and disputes.

2. Each Contestant must register his name, age, and address before the Contest.

3. Each machine competing must be made by the operator (no toys admitted), and must be built along practical lines.

4. The Board of Judges shall have the right to reject any entry, the rejection of which they deem advisable.

5. Trials shall start from a given point indicated by the Starter, and distance shall be measured in a straight line from the starting point to where the model first touches the ground.

6. There shall be no restrictions as to the design, weight, form or amount of power; but the power must be self-contained in the model.

7. Each Contestant shall have three trials.

8. No trial shall be considered official unless the Model flies over 100 feet from the starting point. (The qualifying distance may be changed by agreement between the Club and Starter, provided the Contestants are notified.)

9. The longest flight in the three trials shall be counted for the prize.

Stability in Model Aeroplanes is a subject about which much is now known, and every model designer and builder

should try to find out all he can concerning it. The following article, bearing the above title, and written by Mr. Oliver M. Prentice for *Fly Magazine*, is a very thorough and practical treatise upon the subject, and explains it clearly:

"An aeroplane is said to be in equilibrium when its center of pressure coincides with its center of gravity. To keep a heavier-than-air machine stable, the center of pressure and center of gravity must coincide, for the movement of one must result in a movement of the other in order that the machine may maintain its equilibrium.

"There are two directions in which stability is to be maintained, viz., laterally and longitudinally. Of the two, the lateral stability has puzzled designers the most. Correct design will make longitudinal stability almost inherent.

"In all models the center of gravity will remain the same, while the center of pressure will vary throughout the flight. The next question is how to control the movements of the center of pressure. In standard machines it is accomplished by movable surfaces between the planes, or at the rear edge of the planes, and by flexing the wings, thereby decreasing the lift on one side and increasing it on the other, and thus bringing the center of pressure back to its proper position.

"In designing a model, its stability is the first point considered, for if it is deficient in this respect it will never be successful. Longitudinal stability should be first considered because it controls the length of the main frame. This is again important because it controls the length of rubber strand to be used.

"Longitudinal stability can be obtained by placing the planes (elevator or tail, and main plane) a good distance apart. Some model builders advocate using only an elevator, but this applies only to models driven by propellers in the rear. It is well to note in passing that models of this type hold all records.

"The method by which two planes in model aeroplanes retain longitudinal stability is as follows: If a gust of wind strikes the under side of

the elevator, it has a tendency to force it up, but to do this it has to force up the large plane, which gives a greater lift and thereby holds the model in equilibrium. A gust striking the upper side of the elevator will have the same effect, inversely. The elevator should always have a greater angle of incidence than the main plane, but it should not be carried to extremes.

"In several of the most successful models, the main plane is placed flat and the elevator is given a positive angle. This applies only to models of which the planes have curved surfaces. A curved surface will give a lift when flat, while a horizontal surface will not.

"Lateral stability in models is greatly affected by the twisting of the rubber-strand motors. They exercise a strong unbalancing tendency, which must be overcome. One of the methods used is the dihedral angle, but this is carried to too great an extreme in many cases. The greater the dihedral, the less will be the lift, necessitating a larger plane, and thereby increasing the weight of the model and requiring a greater expenditure of power.

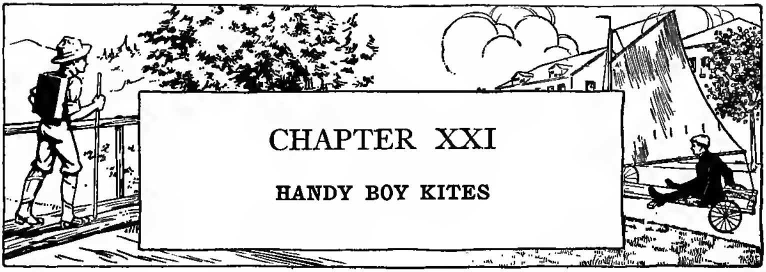
"The method by which the dihedral effects stability is as follows: When a gust of wind strikes under one side of the plane, it pushes it up, thereby tilting the other side down. The side lifted up by the wind will then have a greater dihedral and therefore less lift, while the other side will exert a greater lift and tend to restore the machine to lateral equilibrium. The dihedral angle acts well, but unless it is carefully worked out it will have a tendency to make the model circle.

"Another method that is extensively used is that of placing upturned wing tips on the extremities of the planes. These do not reduce the lift of the plane to any extent, and they do damp out oscillations much quicker than any other.

"Still another method that has not been tried to any extent, is the use of a plane with a small inverted curve.

"Two propellers revolving in opposite directions is probably the best method for obtaining lateral stability.

"If a model designer and builder looks well after the stability of his machine, it will surely be a success, if the other features are worked out as well in proportion."



CHAPTER XXI

HANDY BOY KITES

TAILLESS kites have supplanted the tail variety in degree of popularity, and are now recognized as the better form of fliers, as they fly higher and steadier, and pull strong enough to make possible the sending aloft of flags and streamers on the flying line. One of the practical purposes to which kite flying is now applied, and for which the tailless kite is used, is advertising, and it is a common sight on a day favorable for kite flying to discover high in the air, above the principal business thoroughfares, picnic grounds, and fair grounds, advertising banners, dummy acrobats performing upon trapese-bars, full-size aeroplanes, and many other contrivances, floating about at the end of a cord or wire connected to a kite line. Another advertising scheme for which they are used is releasing bundles of handbills from great heights to cause them to scatter over a wide territory.

The Conyne Kite (Fig. 466), invented by Silas J. Conyne of Chicago, is one of the best forms of kites to use for carrying flags and banners, on account of its great lifting power. This is a patented kite, but Mr. Conyne has kindly permitted the publication of a complete description of its con-

struction, and granted you handy boys liberty to make as many for your own use as you wish. Mr. Conyne has flown his Conyne (Co-9) kite to an altitude of 7,580 feet, or a trifle under 1½ miles, and 3,000 feet above the point at which it disappeared from view. For this flight over 11,000 feet of line were used.

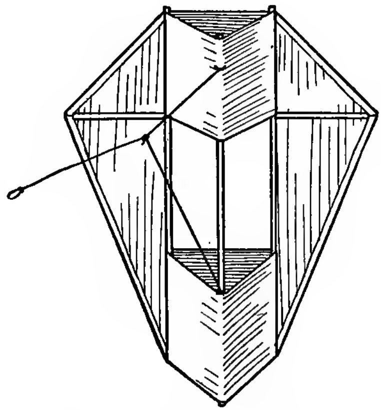


FIG. 466. — The Conyne Kite.

The Kite Sticks may be cut from any light-weight, straight-grained wood. Short sticks can be whittled out with a sharp jack-knife, but for sticks of the length of those required for this kite, the most practical way is to cut them with a saw or draw-knife, because it is hard to whittle long pieces without splitting or cutting them too thin in places.

Figure 467 shows the dimensions of sticks *A* and *B*. Stick *C*, the third stick of the cell framework (Fig. 468), is of the same size as sticks *A*. Notch sticks *A* near the ends, as shown in Fig. 469, to receive the framing string; notch the ends of stick *B*, as shown in Fig. 470, for the same purpose; and notch the sides of sticks *A* and *B* (Fig. 471) at the points where they are to lap one another, which points are located by measurements in Fig. 467, so the connecting cords cannot slip when tied.

Picture-wire, or a strong wrapping-twine, should be used for

Framing the Sticks. First attach sticks *A* to *B*, then connect the ends of sticks *A*, temporarily, with wire or string

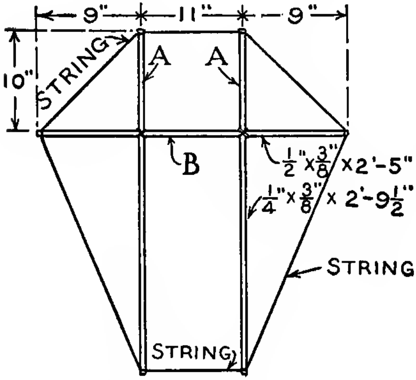


FIG. 467. — Framework of the Conyne Kite.

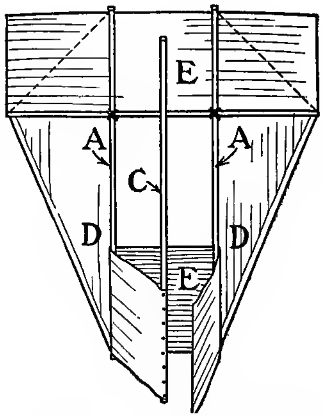


FIG. 468. — How the Covering is Put On.

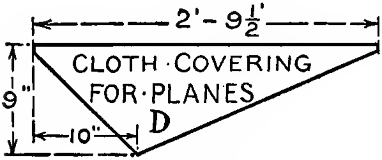


FIG. 472.

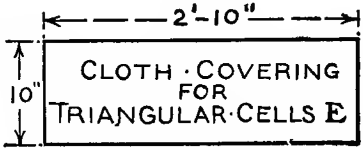


FIG. 473.

FIGS. 472 and 473. — Patterns of Covering Pieces.

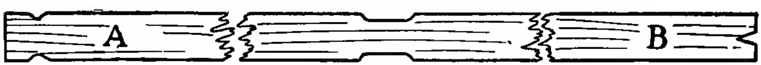


FIG. 469. — Notch Ends of Sticks *A* like this.

FIG. 471. — Notch Sides of Sticks *A* and *B* like this.

FIG. 470. — Notch Ends of Stick *B* like this.

fastened around the notches at the ends. The distance between the centers of the ends should be exactly 11 inches, as shown in Fig. 467. Tie another piece of wire or string to the upper end of each stick *A*, run them through the notches in the ends of stick *B*, and tie to the notch in the lower end of sticks *A*. Figure 467 shows the framework completed thus far.

Covering the Framework. Cambric, or any strong dress-lining material is best for covering the planes *D* and the cells *E* (Fig. 468), though almost any closely woven light-weight cloth that your mother can spare you will do. Figure 472 shows the pattern for the plane strips *D*, and Fig. 473 shows the strips for the cells *E*. Tack the cell-covering strips to sticks *A*, one at each end, with an equal projection each side of the sticks; then pass the ends through the framework, and tack to the ends of stick *C* (Fig. 468). Use about No. 4-oz. tacks for tacking the cloth.

With the cell strips in place, turn over the framework, and tack the long edge of the plane strips *D* to sticks *A*; then lap the shorter edges over the framing wire or string, and glue them neatly to the opposite face of the cloth. Planes *D* should be allowed to bag a little in the center.

The Bridle is attached to stick *C*. Tie the upper end of this 3 inches below the upper end of the stick, and the lower end 10 inches above the lower end (Fig. 466).

The Conyne kite sold in stores is supplied with a linen

Flying-Line. The kind of cord which a mason uses for his plumb-lines is also good. Be sure to test the strength of whatever string you do buy, before using it, so you may be certain that it will not break when your kite is aloft.

Mr. Conyne, in speaking of his kite, gives the following advice about flying it: " This kite is a good flier, but don't expect it to fly when there is no wind, or try to fly it in a gale. Don't run with it. It will fly from your hand."

FIG. 474. — Flying the Malay Kite.

You boys can have a great deal of fun flying these kites with flags and Japanese lanterns suspended from their lines, and by exercising a little ingenuity you can devise dummy figures with wire frameworks covered with cloth, to send skyward.

The Malay Kite, shown in Figs. 474 and 475, was the first successful form of tailless kite, and is one of the simplest kinds to make. It is a very steady flier, it will fly in a light breeze, and it has good lifting qualities.

The Kite Sticks. Three feet is a good length for a medium-sized Malay. Spruce is the best material for the sticks,

but any soft, straight-grained wood will serve the purpose. Cut the two sticks of equal length, and make them thin and wide, rather than narrow and thick, as shown in Fig. 479.

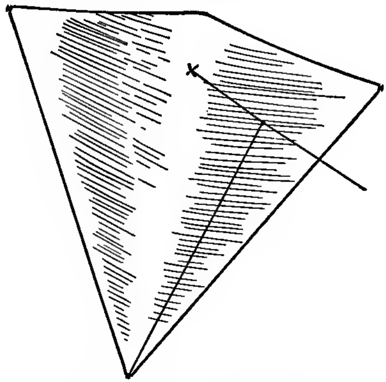


FIG. 475. — The Malay Kite.

Figure 477 shows **The Bow-Stick** with the bow-string attached. Cut a notch in the stick near each end to hold the ends of the string, as shown in Fig. 478. The proper bend for the bow-stick is 1-10 of the length of the stick, plus ½ of that measurement, which will be a trifle less than 1-7 of the length of the stick, as marked upon Fig. 477.

The center of the length of the bow-stick must also be its *center of balance*, and this must be carefully determined, and any necessary correction made, before fastening the bow-stick to the vertical stick. Test the bow-stick by balancing it at its center upon the back of your knife-blade.

Framing the Sticks. Secure the bow-stick to the vertical stick with brads and thread, at a distance from the top of the vertical stick equal to 1-10 of its length, as shown in Fig. 476. The ends of the sticks may be notched to receive the framing-string, but you will get better results if you drive a carpet tack into each end, and tie the string to these

(Fig. 480). With the string tied securely, there will be no chance for the sticks to twist out of position.

A light-weight wrapping-paper, or a heavy tissue-paper should be used for

Covering the Framework. The strong, light-weight, brown paper now so generally used for wrapping-paper makes an excellent covering. Lap the edges of the paper, and paste in the same manner that you would put on the covering of any kite; but, instead of stretching it tight, allow it to have a little fullness. You will notice by Fig. 475 that the paper goes upon the outer face of the bow-stick.

FIG. 477.

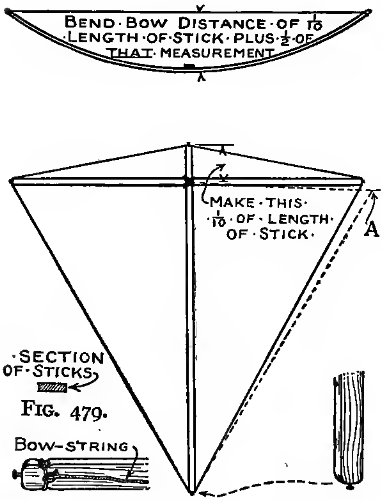


FIG. 478. FIG. 476. FIG. 480.

FIG. 476. — Framework of the Malay Kite.

FIG. 477. — Plan Showing how Bow-Stick is Bent.

FIGS. 478–480. — Details of Kite Sticks.

Attach the Bridle at the intersection of the sticks, and at the lower end of the vertical stick, as shown in Fig. 475, and make it of the proper length so when held to one side it will reach to the point *A* (Fig. 476). Tie the kite string at this point.

The Box-Kite. Of the more pretentious kites, none is as popular as the rectangular box-kite. It approaches

nearest to the form of the biplane aeroplane of any kite yet devised, and is one of the steadiest of fliers.

Box-kites may be purchased ready-made in a number of sizes, but they are not cheap, and it will pay any boy to take the time necessary to make one. While their construction requires considerable more work than the single-plane type of kite, it is not difficult.

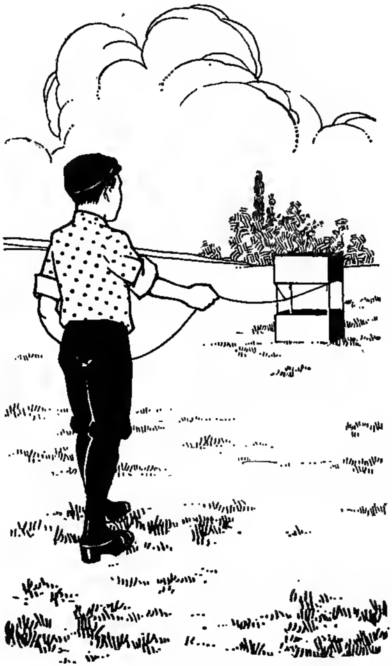


Fig. 481. — Raising the Box-Kite.

Figures 481 and 482 show a kite of scientifically developed proportions. Pine, spruce, and whitewood, are the best materials for

The Kite Sticks, though any strong, light-weight wood of straight grain may be used if easier to obtain. If you live near a lumber yard or planing-mill, possibly you can get strips of just the size you require from the waste heap, for the mere asking, or for a few cents get them ripped out of a board. If not, you will find it easy enough to cut them yourself with a sharp rip-saw.

The Side Frames. Cut the four horizontal sticks ⅜ inch thick and ⅜ inch wide, by 36 inches long (*A*, Fig. 483),

and the four upright connecting sticks (*B*, Fig. 483) ¼ inch thick, ½ inch wide, and 10 inches long. Tack the upright

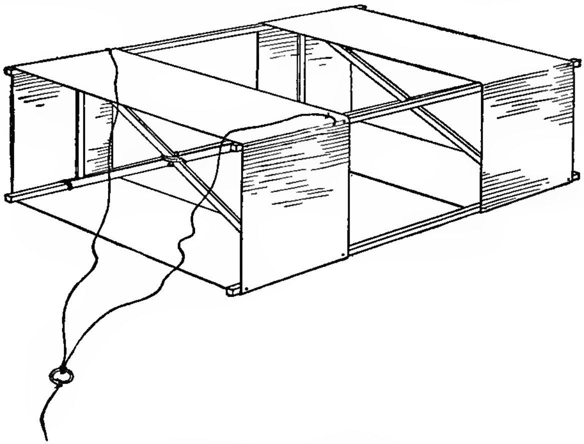


FIG. 482. — The Box-Kite.

sticks to the horizontal ones 6 inches from the ends of the latter, as shown in Fig. 483, using slender brads for the purpose, and clinching the projecting ends. In fastening

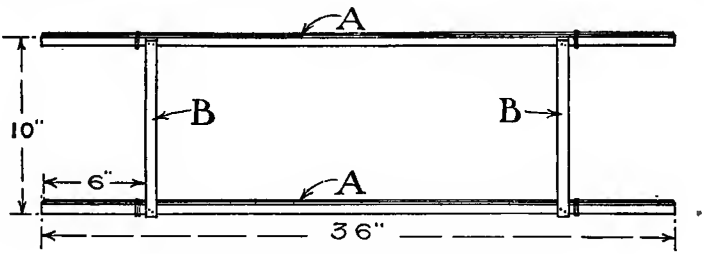


FIG. 483. — Make Two Side Frames like this.

these sticks, be careful to set sticks *B* at right angles to sticks *A*.

After fastening together the side-frame sticks as shown in Fig. 483, lay them aside until you have prepared

The Covering for the End Cells. A light-weight muslin or tough paper should be used for this material. Cheese-cloth will do if you give it a coat of thin varnish to fill up the pores and make it air-tight, after it has been put on. The light-weight brown wrapping-paper now so commonly used is good covering material.

The cell bands for the kite illustrated should be 10 inches wide and 5 feet 9 inches long. If of cloth, they should be

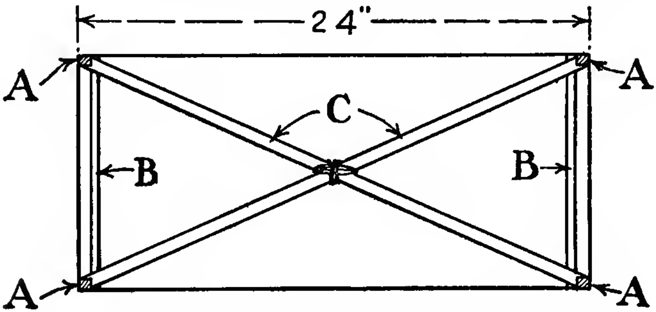


FIG. 484. — Cross-Section of the Box-Kite.

hemmed along each edge to prevent raveling and to make a firm edge. If of paper, the edges should be folded over a light framing-cord and pasted. Sew together the ends of the cloth bands, or paste the ends of the paper bands, lapping them so the measurement around the inside will be exactly 5 feet 8 inches, the proper measurement around the sticks of the finished kite.

Assembling the Kite. Slip the bands over the side frames, spread the frames to their fullest extent, and hold them

in this position by means of sticks sprung in temporarily between upright sticks *B*. Then measure the proper length for the diagonal braces *C* (Fig. 484). These sticks should be notched at their ends to fit over the sticks *A*, as shown in Fig. 485, and they should be a trifle long so they will be slightly bow-shaped when put in place. In this way the frames will keep the cloth or paper bands stretched tight.

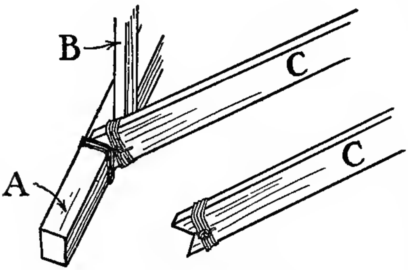


Fig. 485. — Detail of Diagonal Braces.

The notched ends of the diagonals should be *lashed* with thread to keep them from splitting. Lashings of thread around the frame sticks *A*, as shown in Figs. 483 and 485, will keep the ends of the braces from slipping away from the uprights *B*, which is the proper position for them. Bind the braces together at their centers with thread, as shown in Figs. 482 and 484. Coat the lashings with glue after winding them, and the thread will hold its position better.

The cloth or paper bands should be fastened to each horizontal frame stick with two tacks placed near the edges of the bands.

There are several methods of

Attaching the Bridle, but that shown in Fig. 482 is generally considered the most satisfactory. Of course, the kite is flown other side up, with the bridle underneath.

The three-point attachment has cords fastened at the two outer corners of one cell, and a third cord to the center of the outer edge of the other cell; and the four-point attachment has cords attached at the four outer corners of the kite. The ends of the bridle should be brought together and tied at a distance of about 3 feet from the kite. It is a good plan to connect the bridle ends to a fancy-work ring; then the kite-line can also be tied to the ring.

Kite-Reels are as important to the kite flier as the fish-line reel is to the fisherman, and the boy who doesn't own a good reel cannot take the best of care of his string. The short stick on which the string is wound in the form of a figure 8 is a good enough winder for the cotton string used for flying small hexagonal and diamond-shaped kites, but for the larger kind that require a heavy cord, the necessary amount of kite-line is too much to handle easily. Besides, the stick winder cannot be operated as quickly as a regular reel.

Figure 486 shows **A Simple Kite-Reel** that is quickly made. Cut the two upright pieces about 8 inches long, and bevel off their ends, as shown in Fig. 487. Then make two holes through each, boring the holes through both pieces at the same time to

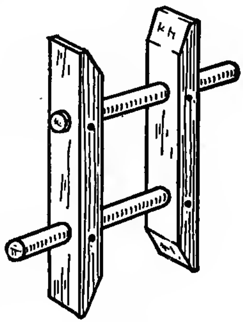


Fig. 486.

Fig. 487.

Fig. 486. — A Simple Kite-Reel.
Fig. 487. — Detail of End.

get them opposite one another. Use old chair rounds, flag-staffs, dowel-sticks, or sticks whittled to about ½ inch in diameter, for the crosspieces. Slip the crosspieces through the uprights, and allow one end of each crosspiece to project (on opposite sides) for handles. In operating the reel, one handle is held in each hand, and the reel is turned with sort of a hand-over-hand movement.

A Good Hand Kite-Reel that can be held in one hand and operated by the other is shown in Fig. 488. Get a ½-lb.

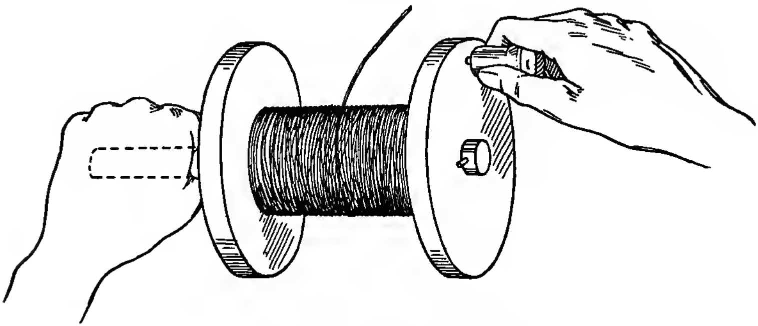


FIG. 488. — A Good Hand Kite-Reel.

size baking-powder can for the winding-spool, locate the center of the cover and bottom end, and with a can-opener cut a hole 1 inch in diameter through each (Fig. 489). Then cut two wooden disks 5 inches in diameter for the spool flanges. These may be cut out of thin wood. If you do not wish to take the trouble to cut them round, just saw off the four corners diagonally, making the pieces octagonal. Bore a 1-inch hole through the center of each piece. Tack the can cover to the exact center of one disk,

as shown in Fig. 490, and the can to the exact center of the other. Then fit the cover on the can, and glue a strip of cloth or heavy paper around the joint to keep the cover from working off, and the spool will be completed.

FIG. 489.

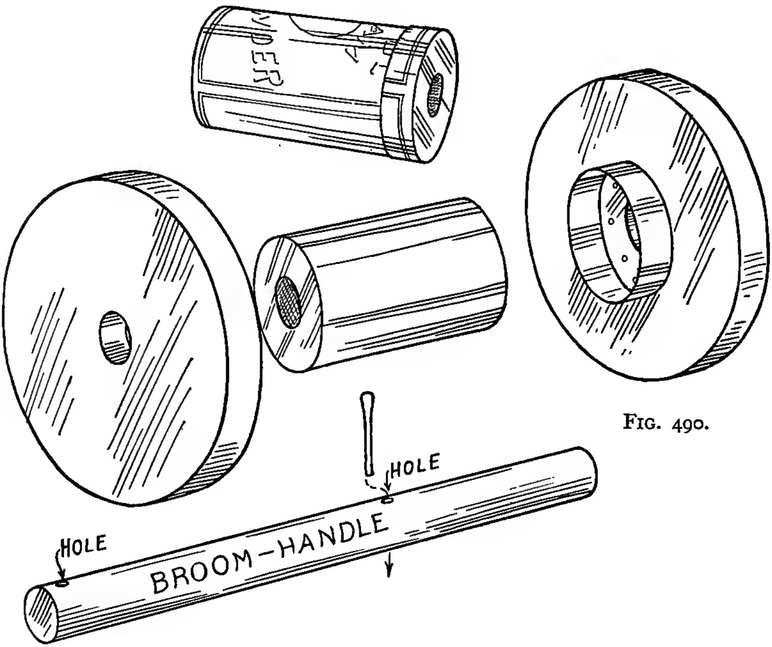


FIG. 490.

FIGS. 489 and 490. — Details of Hand Kite-Reel.

The handle upon which the spool turns is a piece of broom-handle 10 inches or so in length (Fig. 490). Bore two holes through it in the positions shown, for pins to keep the spool in its proper place. Wooden pegs can be cut for pins. For a winding handle, pivot a spool on the right-hand

disk by means of a nail or screw. The inner flange of the spool handle may be cut off as shown in Fig. 488.

Both hands are frequently needed to haul in string quickly enough to bring a kite around into the wind, or to handle it when it pulls very strong, and then there is nothing to do but drop the hand reel upon the ground, unless you

FIG. 492.

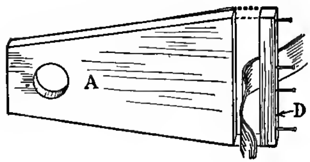
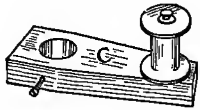


FIG. 493.



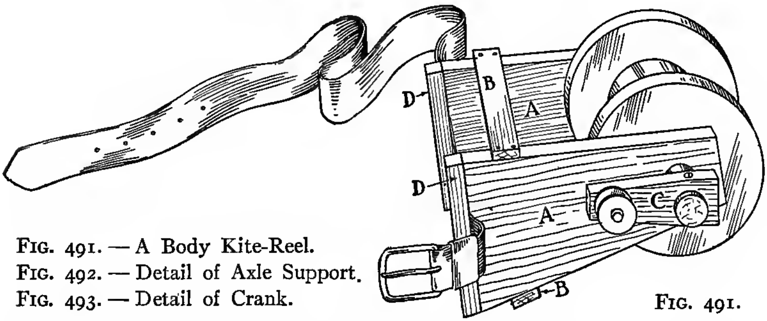


FIG. 491.

FIG. 491. — A Body Kite-Reel.
FIG. 492. — Detail of Axle Support.
FIG. 493. — Detail of Crank.

have an assistant to give it to. This is where the advantage of

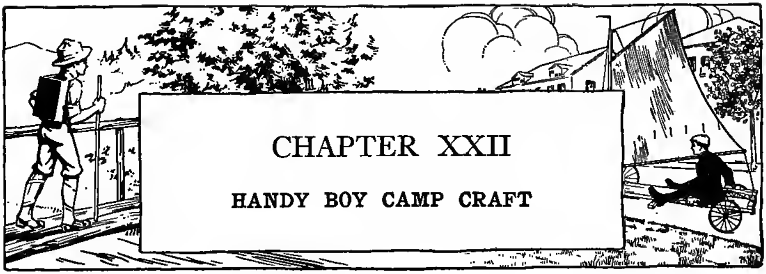
A Body Kite-Reel comes in. With it strapped about the waist, it will go wherever you go, and always be within easy reach. Figure 491 shows one simple to make. The spool of this is made similar to that of the hand reel shown in Fig. 488. If, however, you wish a larger winding-spool, you can use a larger can than the baking-powder can —

a tomato can or syrup can — and increase the diameter of the wooden flanges accordingly. Instead of the spool turning upon the broom-handle axle, the axle turns with the spool, so the spool must be fastened to the axle.

The axle supports *A* (Figs. 491 and 492) should be about 7 inches long, 4 inches wide at the wide end, and 2 inches wide at the narrow end. Cut the holes to receive the axle ends a trifle large so the axle will turn easily. Cut the connecting crosspieces *B* of the right length so there will be about ¼ inch between the ends of the spool and supports *A*.

Cut the crank stick *C* as shown in Fig. 493, bore a hole for the axle end to fit in, bore another hole in the edge for a set-screw to hold the stick in place on the axle end, and pivot a spool in place for a handle. If the hole in the spool is too large for the head of the nail used for pivoting, slip a small iron or leather washer over the nail.

An old belt or shawl-strap should be used for strapping the kite-reel to your body. Fasten this to the ends of the axle supports *A* by nailing the strips *D* to them as shown in Fig. 492.



CHAPTER XXII

HANDY BOY CAMP CRAFT

THE handy boy soon overcomes the awkwardness of the camp tenderfoot, because having learned resourcefulness, he can quickly adapt himself to new surroundings, and is generally able to discover a way out of difficulties, and to make a pretty good guess as to how things should be done. For this reason things usually progress more smoothly for the handy boy than for the boy who has never had to make himself useful at home, and has been allowed to shirk responsibilities.

You will think of lots of things to make while in camp, and therefore should not fail to take along an axe, hammer, saw, jack-knife, nails of several sizes — including a supply of spikes, — tacks, screw-hooks, screw-eyes, staples, wire, cord, and rope, for tools and working material. Nails, hooks, and staples may be carried in tin cans, but they will pack with less waste space in small bags made of canvas, similar to the duffle-bags shown in Figs. 518 and 519.

The suggestions in the illustrations will be found helpful in either the home camp, or a camp in the woods or at the lake.

The Wall Tent is the most commonly used form of tent,

and one of these 7 feet by 7 feet in size can be purchased in most localities for about $6.00; but when spending-money is limited this is a good deal to pay out for a single piece of equipment; therefore, in Fig. 494 I am showing

A Home-Made Wall Tent that is easily made, and one which will serve as a good shelter. Canvas or burlap can be used for the cloth material; or if you are going to camp

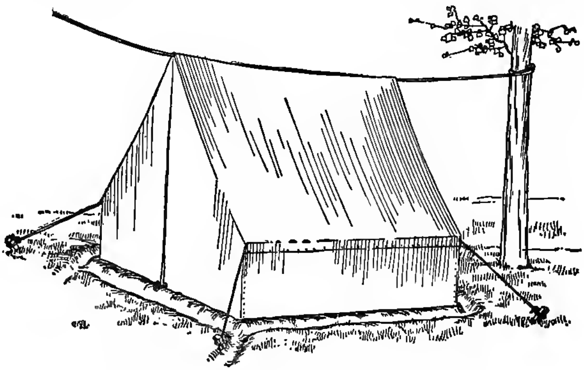


FIG. 494. — A Home-Made Wall Tent.

in the back yard, where you can take chances on the weather, old sheeting can be used. You might not think that burlap would shed the water, on account of it being so loosely woven, but it will, and has been used to great satisfaction. A writer in the *National Sportsman* claims a number of distinct advantages for

The Burlap Tent, after giving it a season's trial. I quote the following from his article: "The tent is made of a very light quality of burlap, or gunny-sack, and on account of the lightness of the material, the tent packs closer and

lighter than any canvas or duck tent, for transporting. Then you will find that when you keep this tent shut up tight, you can have perfectly fresh air within, because the fresh air goes right through the walls and top of the tent. With the ordinary canvas tent you would nearly smother under similar conditions. I scrape a bare place in the middle of the tent floor, when it is raining, and make a fire there and get my breakfast, the smoke going out through the top of the tent and making no inconvenience whatever.

"Then, too, I can sit here in my tent and look out through the walls and see what is going on outside, yet be perfectly private myself. While I am writing this, I am enjoying an occasional glance through the front flap of my tent at an approaching storm, knowing that I am fully protected when it arrives. The flies know the storm is coming, and have covered the front and back walls thickly, but I have none within, because my tent is closed.

"After a windstorm a few nights ago, every canvas tent around me had to be straightened up — one of them had blown down, — but mine needed no fixing because the wind had partly passed through it, and it had thus offered less resistance.

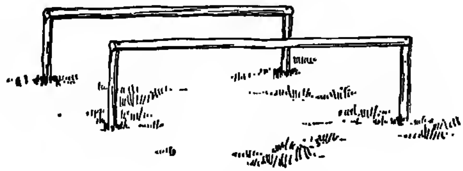
"I have the benefit of the cool morning breezes, and light that is robbed of all disagreeable glare on account of the brown color of the burlap."

If you can get some potato-sacks, they may be used in a pinch. Split them open, and sew them together in as large a piece as is required for the tent covering.

The Wall Supports. Figure 495 shows how four stakes are driven into the ground at the four corners of the tent, and two poles nailed across their tops, to support the walls of the wall tent shown in Fig. 494. Then a strip of canvas or burlap is tacked to the two sides and one end of this framework, as shown in Fig. 496.

The Upper Portion of the Tent may be supported at the ridge either on a *ridge-pole*, or on a rope stretched between two trees. Clothes-posts may be used for the vertical supports, if you pitch your tent in the back yard. Tack the lower edges of the covering to the side poles of the wall framework. The back of the tent should be enclosed with one piece of cloth, sewed to the upper covering and to the lower wall strip, while the front should be made in two pieces and be parted in the middle. The wall framework should be braced at the corners with ropes fastened to the framework and to stakes driven into the ground, as shown in Fig. 494.

Fig. 495.



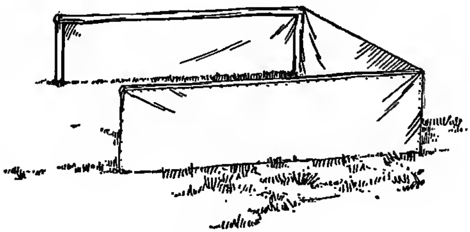


Fig. 496.

Figs. 495 and 496. — The Wall Supports of the Wall Tent.

The Lean-To Tent shown in Fig. 497, with a flap in front that may be raised to a horizontal position as a sun shield in the daytime, or as a rain shield during a light shower, is a popular form of tent. The illustration shows how a fire can be built in front of the tent in chilly weather, with

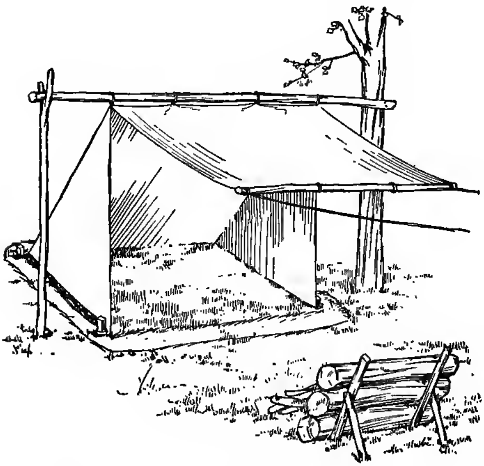


Fig. 497. — A Lean-To Tent and Fire Screen.

A Fire Screen of green logs behind it to reflect heat into the tent. This is the backwoodsman's method of keeping warm.

Make the Lean-To Tent in Three Pieces — one piece to form the front and pitched roof, and two triangular end pieces. The three may be sewed together, or *eyelets* and *tapes*, or tapes alone, may be provided for connecting them. Tapes must be provided along the front and rear edge, and along the center, of the large piece, and on the bottom edge of the end pieces, for fastening the tent to *stakes*, to the *ridge-pole*, and to the *horizontal pole* on the front *flap*. The illustration shows how one end of the *ridge-pole* may be fastened to a tree, and the other in the crotch on the end of a pole driven into the ground. Of course, if you can find

two trees close enough together, the ridge-pole can be fastened across them. Tie a rope to each end of the pole to which the edge of the front is fastened, and extend these over to a tree trunk; or else use a couple of poles having crotches on one end, to prop up the flap. If you pitch this tent in the back yard, you can use clothes-poles for your *tent-poles* and *props*.

After pitching your tent, be sure to

Dig a Trench Around the Outside, with an opening on the side where the ground is lowest, for a drain (Figs. 494 and 497). This trench will catch the surface rain water before it floods into your tent, and will carry it off. Do not put off this trenching, for, if you are caught unprepared, you surely will regret it.

Maybe you have a small cot which you can use in your tent; but if you are going some distance this will be inconvenient to carry, unless you have a team to transport your equipment. You can have a cot to sleep on nevertheless.

A Backwoodsman's Camp Cot. Figure 498 shows a modification of this type of cot which makes a very comfortable bed. First drive four stakes with crotches in their upper ends into the ground, at the four corners of the spot selected for the cot, and rest two poles in the crotches of these stakes, as shown in Fig. 499. These form the cot supports. For the covering, two bags should be made of canvas or heavy burlap, of the right width and length to slip over the ends of the pole supports and meet at the center. Stuff these bags with hay, straw or dried

grass, spreading it out evenly, and you will have as comfortable a mattress as one could wish for. One advantage of making up the covering material in the form of bags, is that they may be used as *duffle-bags* for packing equipment to and from camp.

Figure 500 shows the backwoodsman's scheme for

Making an Open Fireplace. Two logs are placed upon the ground side by side, with one pair of ends close together

FIG. 499.

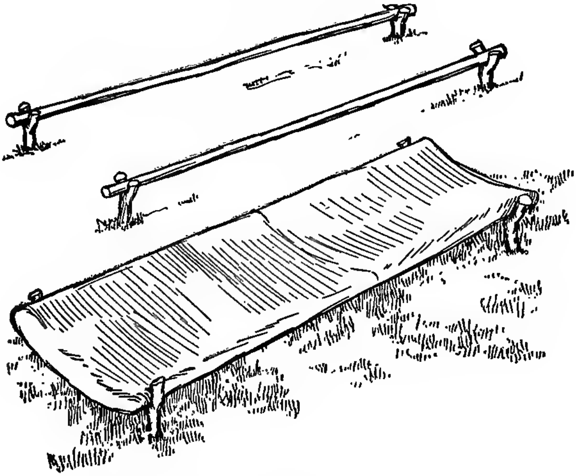


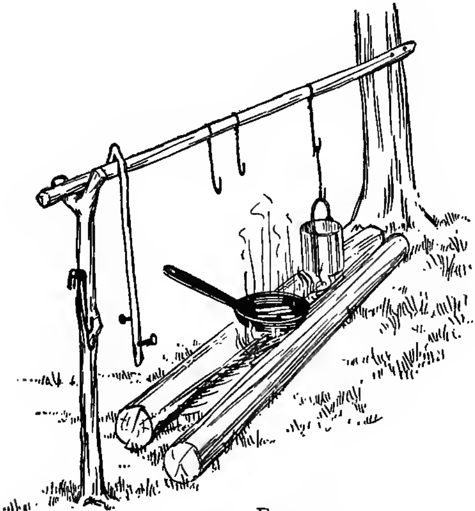
FIG. 498.

FIG. 498. — A Comfortable Camp Cot.

FIG. 499. — The Pole Supports of the Cot.

and the other ends about 12 inches apart, to form the sides of the fireplace. By slanting the logs in this fashion, small utensils can be set across them at the narrow end of the fireplace, and larger ones at the wide end. For suspending

pails and other utensils having handles, a horizontal pole, known as a *lug-pole*, should extend over the fireplace from one end to the other, upon which to hang *pothooks*. The illustration shows how one end of the lug-pole may be spiked to a tree, and the other end supported in the crotch of a pole driven into the ground. The pothooks may be



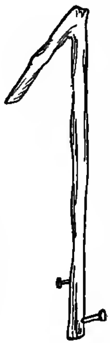


FIG. 501. FIG. 502.

FIG. 500.

FIG. 500. — A Camp Fireplace.
FIGS. 501 and 502. — Pothooks.

either short pieces of tree branches, with a fork left on one end large enough to hook over the lug-pole, and one or two nails driven in near the other end upon which to hang utensils (Fig. 501), or they may be bent out of wire (Fig. 502). By making the pothooks in short lengths, it is pos-

sible to hang utensils at any height above the fire that you wish, by hooking two or three together, and you can thus hang cooked food at the proper height to keep it warm, without burning it.

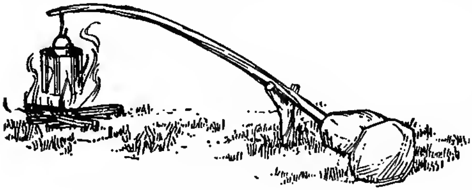


Fig. 503. — A Campfire Crane.

A Campfire Crane like that shown in Fig. 503 furnishes another simple method of suspending food over a fire. Oftentimes a small sapling will be in such a position that it can be bent over for such a crane. The end of the crane can be notched to catch the pail or kettle handle, or a small wire hook may be fastened to it.

A Sheet-Iron Camp Stove like that shown in Fig. 504 makes camp cooking much easier than the open campfire, and its great convenience generally repays one for the trouble of taking it along, especially when the camp is to remain in one place. These little stoves, with one length of stove-pipe, can be purchased as cheap as $1.50.

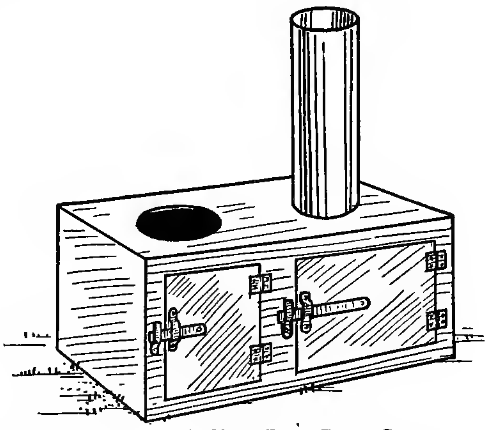
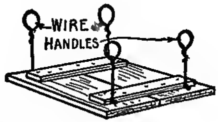


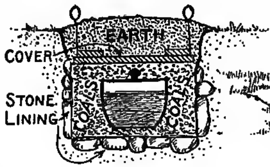
Fig. 504. — A Sheet-Iron Camp Stove.

The Camp Fireless Cooker is becoming more and more popular, because it makes it possible to cook the supper meal in it during the day, without requiring any one of the camping party to remain in camp to tend the fire, the food being made ready and placed within the cooker before starting upon the day's trip.

Here is the way the cooker is made. Dig a pit in a high and dry part of your camp ground, about 2 feet square and 2 feet deep, and line the bottom and sides of this hole with stones (Fig. 506). Then batten several boards together to form a cover that will slip down into the hole (Figs. 505 and 507), and fasten four pieces of wire to it for handles (Fig. 507).

FIG. 507.





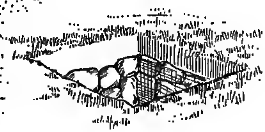


FIG. 505. FIG. 506.

FIG. 505. — Section through the Camp Fireless Cooker.
FIG. 506. — The Cooker Pit.
FIG. 507. — The Cooker Cover.

Your pot of beans, kettle of potatoes, oatmeal, mush, or other food, must be started upon your campfire. While it is cooking, build a good wood fire in your cooker pit, and allow it to burn down into hot embers. Then quickly transfer your cooking utensil, when ready, into the cooker, raking a hole in the embers for it to set in, and fill in around and over the utensil with coals from your large fireplace.

The wooden cover should be fitted down over the top, and the space between this and the ground level should be filled with earth, to make the insulation as perfect as possible.

A Log Bridge. A little creek is often in the vicinity of a camp site, and a handy crossing is not always near at hand. If this creek is not very wide, it is a simple matter to throw two logs across it at the desired point of crossing. Boys

FIG. 509.

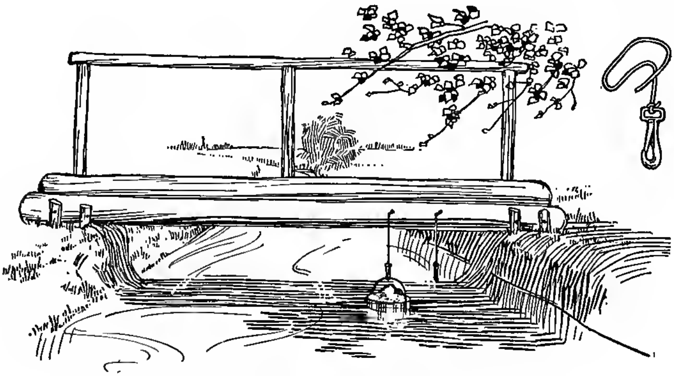


FIG. 508. — A Log Bridge for a Creek.
FIG. 509. — Snap-Hook and Cord for Refrigerator.

do not require a railing on such a bridge, but if girl visitors are expected it is a good plan to provide a railing like that shown in Fig. 508. The end railing uprights should be driven into the ground, and these, and a pair of stakes driven into the ground on the other side of the log ends, should be spiked to the logs to keep them from rolling.

If your camp is located near a lake, you will probably want **A Pier,** and a short one can be built on the plan of the

creek bridge. Of course the outer ends of the logs must be supported upon a couple of stout sticks driven a foot or more into the lake bottom and connected at the top with a crosspiece.

Use the lake, creek, or whatever stream of water near which you are camped, for

A Refrigerator. Drive a few nails into the side of your log pier or bridge, and to each of these nails fasten a piece of stout cord with a snap-hook tied to its end (Fig. 509). The cords should be adjusted to the proper lengths to allow pails to become partly submerged in the water. A stone placed upon the covers of the pails will keep them from bobbing around and upsetting. The snap-hooks will do away with having to untie the cord from the handles when removing the pails. This refrigerator should be located near shore, in the shade of a tree or reeds.

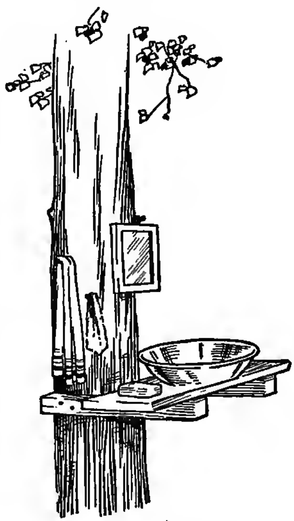


FIG. 510. — A Handy Camp Wash-Shelf.

A Wash-Shelf bracketed to a tree trunk, to hold a wash-basin and soap, is a camp convenience that should not be overlooked (Fig. 510). Fasten your mirror above the basin, and drive a few nails into the tree trunk to hold towels and wash-rags.

A Camp Broom is necessary to keep the grounds in a tidy condition, and Fig. 511 shows how easily one may be made with a stick for a handle, and some evergreen boughs bound to one end of this with wire or cord. If evergreen trees are not at hand, use some weeds or long grasses, for the broom.

FIG. 511. — A Camp Broom.

A Camp Shovel is necessary for trenching around your tent, and will come in handy for many small jobs, such as digging the hole for the fireless cooker, and digging pits into which to throw camp refuse.

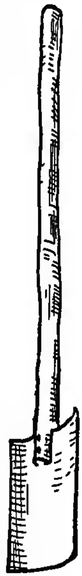


FIG. 512. A Camp Shovel.

An Electric Flash-Light is a very handy article to have in camp for locating things in and about the tent after dark, when you do not wish to bother with lighting your lantern, and as these are cheap any boy can afford to carry one.

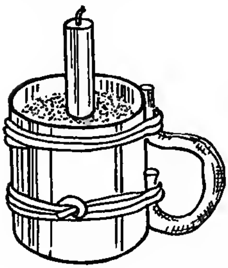
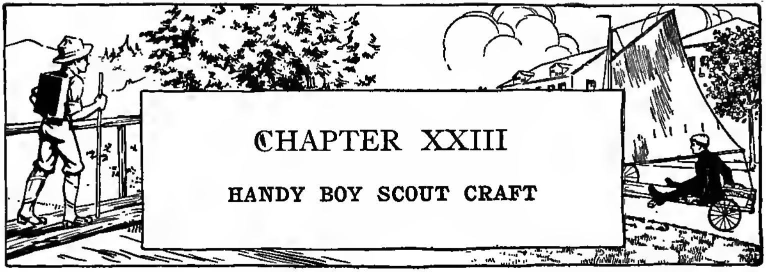


FIG. 513. — A Camp Candle-Stick.

Figure 513 shows how to make **A Camp Candle-Stick** out of an empty tin can, by binding a piece of twisted green branch to the side with wire or cord, for a handle. Set the candle in the center of the can, and fill in around it with sand or earth to support it. As fast as the candle burns down, it can be pulled up out of the can, and the sand or earth allowed to fill in beneath it.



CHAPTER XXIII

HANDY BOY SCOUT CRAFT

One of the finest achievements of the Boy Scout movement has been the awakening of interest in "hikes" to the fields, forests, and mountains among city boys who have spent most of their lives surrounded by paved streets, with little or no opportunity to visit nature's workshops, and the organization of "hikes" and camping trips to take them there.

The best "hikes" usually require a day's time, so the lunch proposition must be taken care of or the "hikers" will be fairly starved before the tramp is over. Of course a boy can't carry a bag of lunch in his hand, for he needs both hands for other purposes, and a coat pocket is too full of other things to permit of crowding in enough lunch for a hungry boy. Therefore, food must be "packed" in some other way, and the best scheme is to have a regular knapsack that can be strapped upon the back army-fashion (Fig. 514), in which to carry it.

A Scout Knapsack is not difficult to make, as you will see by Figs. 515, 516, and 517, and if you can get your mother or sister to do the sewing on her sewing-machine, you will be relieved of the biggest part of the work. Any

handy boy, however, will not find the sewing hard to do.

For Material, use brown or white canvas, khaki, or denim. Figure 517 shows the pattern for cutting the front, back, ends, and flap, with all of the necessary dimensions. The dotted lines indicate where the cloth is to be folded. In cutting the cloth, about ¼ inch should be allowed all around, outside of the given measurements, for the making of seams. All sewing must be done with very stout linen thread, and to prevent the fraying of edges it is best to bind them with tape or braid.

Fig. 514. — A Scout Knapsack.

The *pocket* upon the inside of the *flap* may be divided into three compartments, by making rows of stitching as shown in Fig. 515. Tapes should be stitched to the flap and pocket-front of the large pocket, so they may be tied to keep the pocket shut. *Small pock-*

ets to hold small articles may be made by sewing pieces of canvas to the sides of the knapsack, inside. A doubled tape, with three or four buttonholes worked in it, should be stitched to the end of the flap of the knapsack, and a button sewed to the under side of the bottom of the knapsack to button it on to (Fig. 515).

FIG. 520. FIG. 519. FIG. 518.

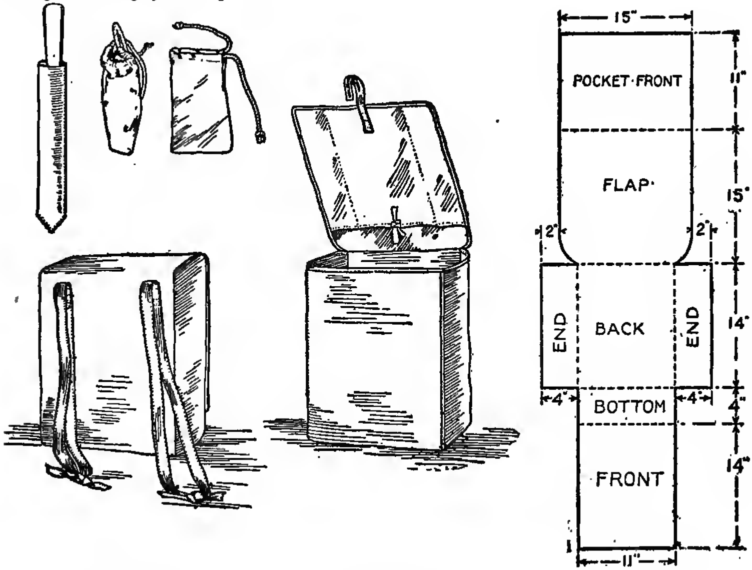


FIG. 516. FIG. 515. FIG. 517.

FIG. 515.—Front View of Knapsack with Flap Opened.
FIG. 516.—Back View of Knapsack with Flap Closed.
FIG. 517.—Pattern for Cutting the Cloth.
FIGS. 518 and 519.—Duffle-Bags.
FIG. 520.—Knife Sheath.

Figure 516 shows the *shoulder-straps*. These may be made out of strips of canvas, doubled, and stitched along both

edges to make them firm. Cut them about 2 inches wide and 30 inches long, and stitch them at their centers to the back of the knapsack, in the positions shown in Fig. 516. The sewing of these straps should be reënforced with four or five rows of cross-stitching, to make a very strong job. The ends of the tapes can be sewed together when you have determined the proper length to reach over your shoulders and down under your arms; or they may be tied as shown, so they can be readjusted at any time to fit over heavy clothing.

Duffle-Bags. Figures 518 and 519 show two small duffle-bags of the form with which knapsacks are usually supplied. They are provided to hold small articles, and keep them from scattering about. Army knapsacks have four of these little bags, measuring about 5 inches in depth, and varying in width from 3 to 5 inches. To make one, take a piece of light-weight canvas or *drilling*, of twice the width desired for the finished bag, and stitch along one side and across the bottom; then make a hem across the top for a draw-string, for which a piece of heavy cord, knotted at the ends, should be used.

Knife Sheaths should be made as shown in Fig. 520, out of leather or pieces of heavy canvas.

Packing the Knapsack. For a short "hike," it is not likely that you will carry much more than a package of lunch, unless you add a tin plate, knife and fork, and cup. Then, the matter of packing is not important, except that the articles that might rattle together should be wrapped. But if you take a small outfit along, it will be necessary to

pack carefully, in order to get everything in and make the load carry easily. The weight must be evenly balanced by a careful distribution of heavy things, and solid and pointed articles must be placed in the front of the knapsack so they will not rub against you and "wear a hole in your back."

A Flexible Rubber Cup is the most convenient form of drinking cup to carry when on a "hike," because it can be folded compactly, and stuck in your pocket within convenient reach. Such a cup costs 15 cents. In case you have nothing but a tin cup, the handiest way of carrying it is by slipping the handle on to your belt, or on to an end of your suspender. It can be reached more quickly there than if it were packed in the knapsack.

There are a number of ways of

Getting a Drink without a Cup. With a little practice, you can learn to suck water from a creek while lying flat, and if the stream has a strong current to it, it is only necessary to turn your head facing up-stream and allow the water to run into your mouth.

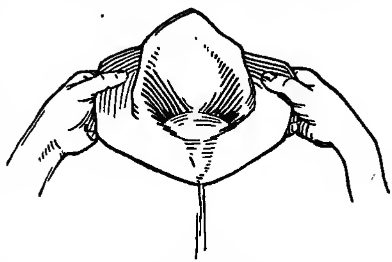


FIG. 521.—You can Drink from your Scout Hat.

If you wear a soft *fatigue hat* similar to the regulation boy-scout hat, the top of the crown can be pushed down cup-shaped, and with this partially filled with water, the water can be allowed to run out over the hat-brim into your mouth (Fig. 521).

A Folded Paper Cup is extremely simple to make, when you know how. The diagrams for folding one are shown in Fig. 522. Tear a piece of paper so it will be 8 or 9 inches square (*Step* 1), fold the corner *A* over to the opposite corner (*Step* 2), fold corner *B* over to the position shown in *Step* 3, fold corner *C* over to the position shown in *Step* 4, turn down the upper corner *D* as in *Step* 5, and turn down

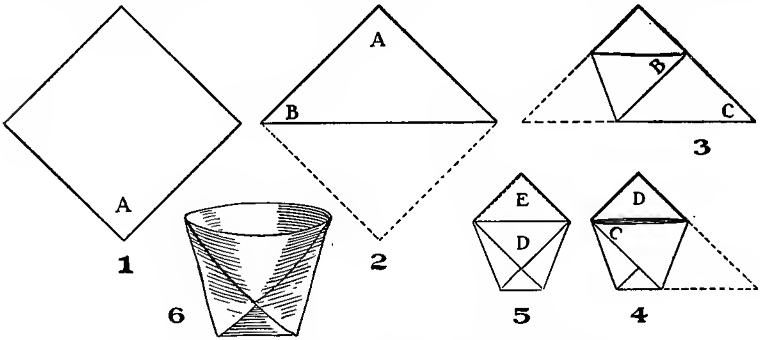


FIG. 522.—How to Fold a Paper Drinking-Cup.

corner *E* on the opposite side (*Step* 6), spread the upper edges apart, and the cup is completed.

There are various

Signs of the Trail, used in the woods, in the mountains, and on the prairie, an understanding of which belongs in the education of every boy scout. Every woodsman, every Indian, and every native of the wilds is familiar with these signs, and every frequenter of unfamiliar territory should know how to use and how to read them, in order that he can so "blaze" a trail that he will be able to retrace his steps back to his starting point. It is very necessary for the

leader of a party on a "hike" to know how to indicate to those following him, perhaps some distance behind and out of his vision, the turns, "short cuts," etc., he is making, and naturally it is of equal importance for the followers to be able to read them aright.

You have all heard of

Blazed Trails, where the bark is chopped off tree trunks by means of an axe, to indicate directions. That is the woodsman's trail marking method. Figure 523 shows the four common forms of *blazes*, with the meaning of each. The "Straight Ahead!" blaze is chopped upon the side of the trunk facing the trail, the "Turn to Right!" blaze is cut to the right side of a "Straight Ahead!" blaze, and a "Turn to Left!" blaze is cut to the left of a "Straight Ahead!" blaze, while three blazes in a row, vertically, mean "Warning!" or a caution to be watchful for danger ahead.

The Twig Signs consist of ends of tree branches or bushes broken as shown in Fig. 524, with the broken ends pointed away from the direction to be taken, and the advantage of this method of trail marking is that, in returning, the silver sides of the leaves of the broken twigs are toward you, and are thus easily distinguished from the surrounding leaves.

The Knotted-Grass Signs shown in Fig. 525, are used in marking a trail across a prairie, or where there are no trees to blaze, and

The Stone-Heap Signs shown in Fig. 526 are used in simi-

FIG. 523.

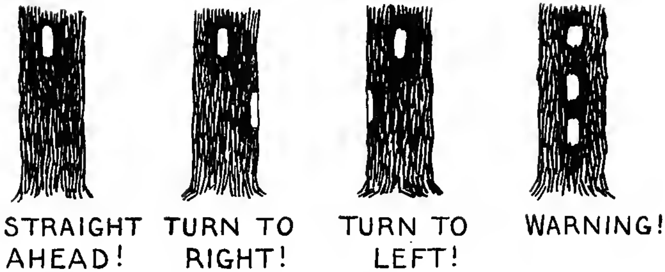


FIG. 524.

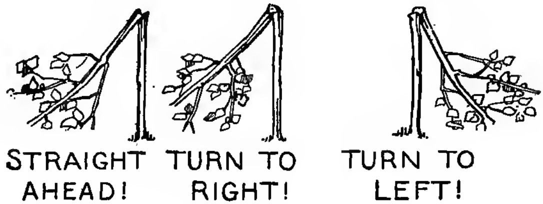


FIG. 525.

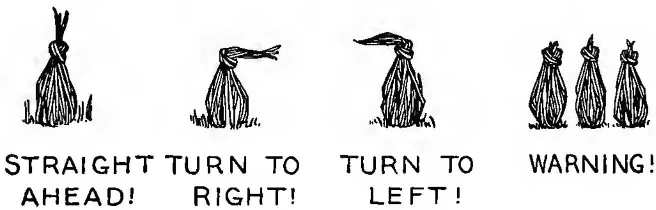


FIG. 526.

FIG. 523.—Tree Blazes.
FIG. 524.—Snapped Twigs or Branches.
FIG. 525.—Knotted Bunches of Grasses.
FIG. 526.—Stone Heaps.

lar places, and in the mountains. You will notice that there is a similarity in the code of all these sets of signs, and after learning the code of one it is easy to apply it to all four sets of signs.

Of course it is a good plan to always have a compass with you when tramping about in unknown places, with no stream, railroad, or other guide near you, by which to keep your directions straight; but there usually comes a time, when the compass has been left behind, when you need it badly. In such an emergency you can use

Your Watch as a Compass. Hold it in your hand as shown in Fig. 527, with the hour hand pointed toward the sun; then half-way between the point of the hour hand and the 12 o'clock figure will be South. If the face of a watch were divided into 24 hours, the 12 o'clock mark would always lay in the direction of South; but as it is divided into only one-half that many hours, it is necessary to take the point half-way between the hour hand and 12 o'clock. Thus, at 4 P. M. South will lie approximately in the di-

FIG. 527. — Using a Watch for a Compass.
Hold the watch with the hour hand pointed towards the sun. Then half-way between the hour hand and 12 o'clock is south.

rection of 2 o'clock, while at 8 A. M. it will lie approximately in the direction of 10 o'clock.

In an article in the Chicago *Record-Herald*, entitled

Getting Lost in the Woods, the following practical advice has been set forth by the late Edwyn Sandys, distinguished hunter, sportsman, and author, and it is advice to which every boy scout should give heed.

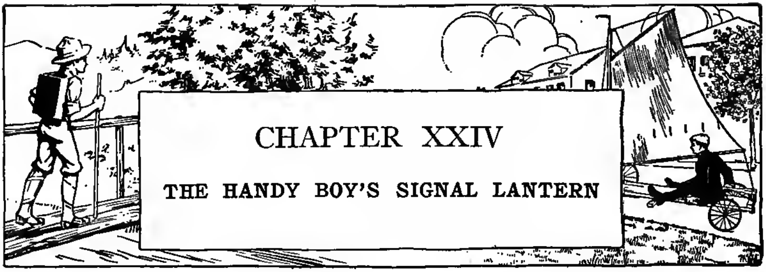
"It is curious how similar is the effect of being lost upon different types of men. Some at first will laugh and make light of the matter, while others become instantly afraid. But sooner or later one and all will be howling for help, and finally go aimlessly charging through the woods. The fact is that few men know how to take care of themselves in an emergency. Probably they all have read more or less of the voluminous literature treating of forest life, yet when the hour of trial comes fear takes possession of them, and the book knowledge vanishes as the mists of the morning.

"It is all very fine to say study the moss upon the north side of the tree, but a lost man may happen to be in woods where for miles there is no moss upon any side of any tree. I never could steer by the moss, and I have yet to meet a man who can. Then again there is the theory that the heaviest branches of a tree are always upon its southern side. That would be both interesting and extremely useful if true, which it is not; that is, as applied to the woods at large. I have found that the branch of any ordinary tree will best develop in the direction of the greatest amount of sunlight. In other cases it is probable that any preponderance of heavier limbs toward any particular side of a characteristic growth would mean that the prevailing winds came from the opposite quarter. The wind has much to do with the shaping of trees, yet how often are seen magnificent elms, maples, sycamores, dogwoods, basswoods, oaks, and conifers, standing isolated in broad pastures, exposed to the full fury of every wind that blows, yet remaining as symmetrical as though carefully

modeled by some master hand? In such cases, if ever, the influence of unfavorable winds would have full play, yet the trees in question are many times more shapely and better balanced than the average forest tree. The north-side theory is all tommyrot. Find the way the worst winds blow, and you will find which way your best trees will grow.

"When lost in heavy woods, one's best course, when possible, is to climb a tall tree and endeavor to get some sort of bearings. In any event, keep going as straight and as far as possible. If one travels far enough, he is bound to come out somewhere, and just where that may be does not matter, as long as one comes out at all. When working in strange woods, I endeavor either to get into a narrow valley or else to work along a trout or other stream. In either case there is little excuse for getting lost, for one scarcely can travel out of a valley without noticing the ascent, while the man on the stream has only to mark its flow at the starting point to learn if he is bound up or down stream, and then be guided by the current when he concludes to turn campward.

"What is usually termed a right-footed man will, when lost in the woods, gradually circle to the left, while a left-footed man will circle to the right. The circling is characteristic, and is explained by the fact that a man will step a trifle farther upon his strongest side, as a man will catch a ball or perform any other rapid action with his most useful hand as he may happen to be right or left handed. If a searcher knows whether a lost man is right or left handed, it may be that the knowledge will aid the quest."



CHAPTER XXIV

THE HANDY BOY'S SIGNAL LANTERN

HERE is a simple piece of apparatus with which you boys can communicate after dark from your bedroom window with the boy across the street, or from your tree-hut with a boy on the ground; and when you go camping you and your companions can use it to flash messages from place to place.

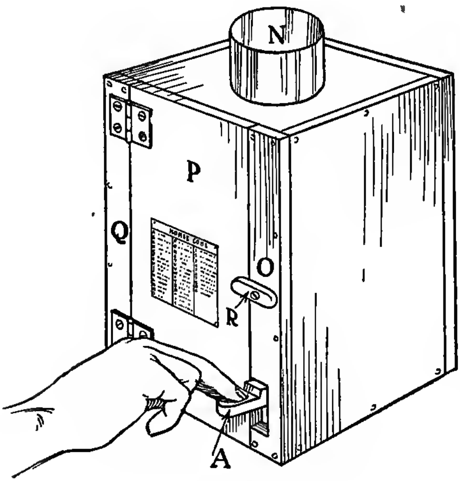


FIG. 528.—The Signal Lantern.

Get a box about 12 inches long, 8 inches wide, and 8 inches deep for

The Lantern Box. This will be the most convenient size. Figure 528 shows the completed piece of apparatus, with the key that controls the lengths of the signal flashes (*A*) in operation, while Fig. 529, a *cross-section*, and Fig. 530, a view of the inside of the lantern box, explain

How the Flashes are Made. You will see by the illustrations that when the *key lever A* is pushed down, it pulls up, by means of a cord *B*, a shutter *C*, until the hole bored through its center (*D*) coincides with a hole (*E*) in the front of the box.

Make the Shutter *C* about 4 by 5 inches in size (Fig. 532), and bore the hole *D* through it 1½ inches in diameter.

FIG. 531

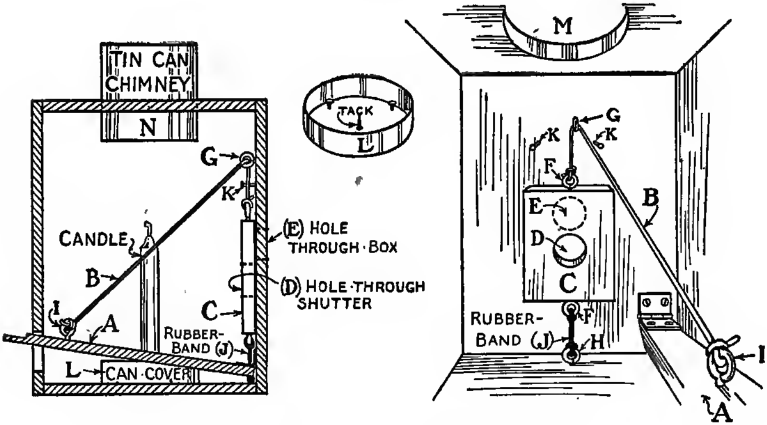


FIG. 529. — Cross-Section. FIG. 530. — Inside of Lantern.
FIG. 531. — Candle-Holder.

Bore hole *E* through the box front, of equal size. Screw a screw-eye into the center of two opposite edges of the shutter block (*F*), another into the inside of the box 3 inches above hole *E* (*G*), and another into the bottom of the box under hole *E* (*H*, Fig. 530).

The Key Lever Stick *A* (Fig. 533) should be enough longer than the inside depth of the lantern box so its key will stick

about 1½ inches outside of the box (Fig. 529). Prepare the key end as shown in Fig. 533, screw a screw-eye into the stick at *I*, and hinge the square end to the inside of the front of the box ½ inch above the bottom (Figs. 529 and 530).

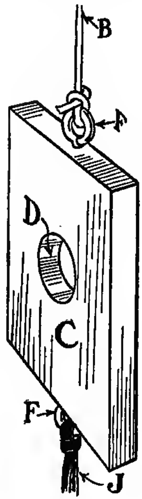


FIG. 532. — Shutter.

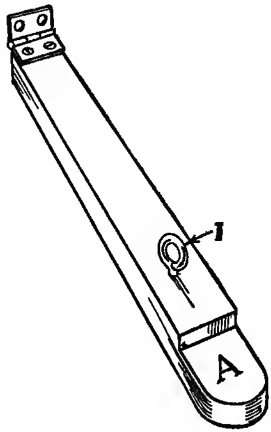


FIG. 533.—Key Lever Stick.

The Key Connections. Tie a piece of stout cord to the upper screw-eye *F*, slip it through screw-eye *G*, and tie to screw-eye *I* (Fig. 530), allowing just enough length so when the key lever stick is perfectly horizontal, the two holes *D* and *E* will come opposite one another. Connect the lower screw-eye *F* and the screw-eye *H* with a heavy rubber-band (*J*). The rubber-band will spring the shutter back to the position shown in Fig. 530, and raise the key end of the lever stick to the position shown in Fig. 529. Drive a couple of small nails into the box at the proper height so the shutter will strike against them when raised until holes *D* and *E* come opposite one another (*K*, Figs. 529 and 530).

Light your Lantern with a tallow candle. Tack a can

cover, with a carpet tack driven through its center from the bottom (*L*, Figs. 529 and 531), to the bottom of the lantern box as a *candle-holder*. A large hole in the top of the box will carry off the heat from the candle (*M*, Fig. 530), and it it best to fasten a can, having both ends removed, in this hole for a *chimney* (*N*, Figs. 528 and 529).

Make the Back of the Lantern Box out of three pieces (*O*, *P*, and *Q*, Fig. 528). Cut a notch in the edge of strip *O* in the proper place, and of the right size, for the lever stick to work in. Screw the wooden *button R* to strip *O* as a means for locking the door.

Operating the Lantern. Communication is carried on by means of *long* and *short flashes* of light. A short flash is made by a quick tap upon the key, and a long flash by holding the key for an instant. Use the Morse *telegraph code*, a copy of which is shown in Fig. 534, as your signal code, making your short flashes for the *dots* of the code, and your long flashes for the *dashes*. Make a correct copy of the code upon a piece of paper, and paste this to the back of the lantern box, as shown in Fig. 528, so you will have it before you for reference when operating the light.

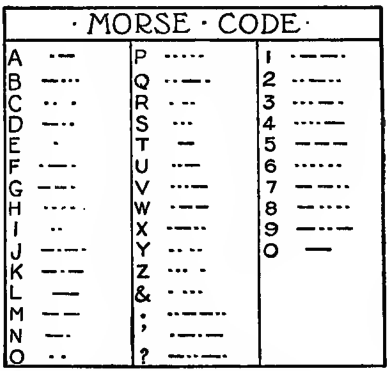
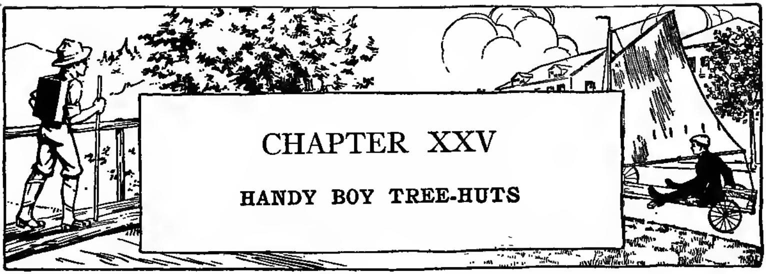


FIG. 534. — Signal Code.



CHAPTER XXV

HANDY BOY TREE-HUTS

EVERY boy at one time or another builds a shanty in the back yard or in a near-by vacant lot, and where one or more trees are available preference is generally given to a tree-hut. Not only does a location upon the tree branches appeal to the romantic side of the handy boy's nature, but because of the fact that when the ladder leading to the entrance has been removed and hidden the hut is inaccessible to passers-by, there is a feeling of security in knowing that neither tramps nor unfriendly boys can disturb it.

The Construction of the Aerial Foundation for a tree-hut is the most important part of the work. This of course must be very carefully planned and securely put together. Its form will depend largely upon the size of the hut, but principally upon whether one, two, or three trees are used for supports. Where two or three trees are close enough together, it is advantageous to build the hut between them; again, a most satisfactory plan is to construct the hut in the crotch of a large tree, or to build it around the tree, extending brackets from the trunk to all four sides of the platform.

The-tree hut shown in the course of construction in Figs.

FIG. 541.—COMPLETING THE PLATFORM.

FIG. 542.—HOISTING BUILDING MATERIAL.

FIG. 543.—READY FOR INSPECTION.

541 to 543, rests in the branches of a cotton-wood tree at the rear of the Cotter home in Oak Park, Illinois; and since the finishing touches have been applied, is as fine a specimen of hut as any boy could wish for. For over ten years a hut has occupied this same tree, having first been built by the oldest Cotter son, and remodeled from time to time by the three younger sons as each in turn fell heir to the title to it. During the existence of the hut, the Cotter boys, and those friends who have been lucky enough to receive invitations to visit, have made their sleeping quarters within it, from early each spring until late each autumn, and with the recent installation of a small stove and electric lighting, there now remains little to be desired in the way of improvements. Probably few of you boys will have as splendid a tree as this in which to build your hut, but if you have you will be able to see just how to construct the foundation platform, by carefully examining the photographs.

The tree-hut shown in Fig. 535 has been designed with a two-tree foundation.

First of all,

Construct your Ladder, splicing together pieces of 2-by-4 for the side *rails*, and nailing 1-by-2-inch strips across them for *rungs*.

Figure 536 shows a large detail of

The Platform Framework, and Fig. 537 shows the first steps in its construction. If possible to get them, use 2-by-4s for the framework; otherwise, nail together two

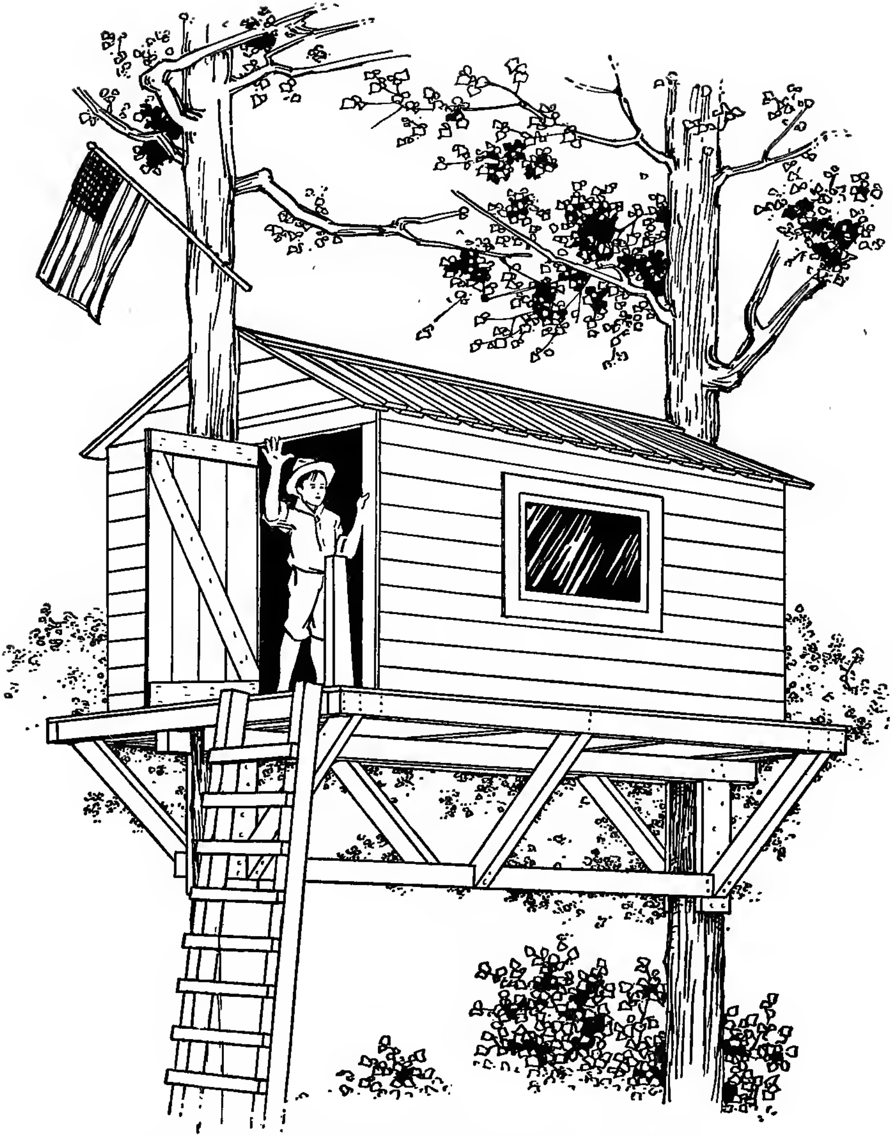


FIG. 535. — A Handy Boy Tree-Hut with a Two-Tree Foundation.

pieces of 4-inch board for each member. The four pieces of board *A* (Fig. 537), should be 8 or 10 inches wide, and 3 feet long, and should be spiked to opposite sides of the trees with their tops on an exact level with one another. Then the horizontal pieces *B* should be set upon the tops

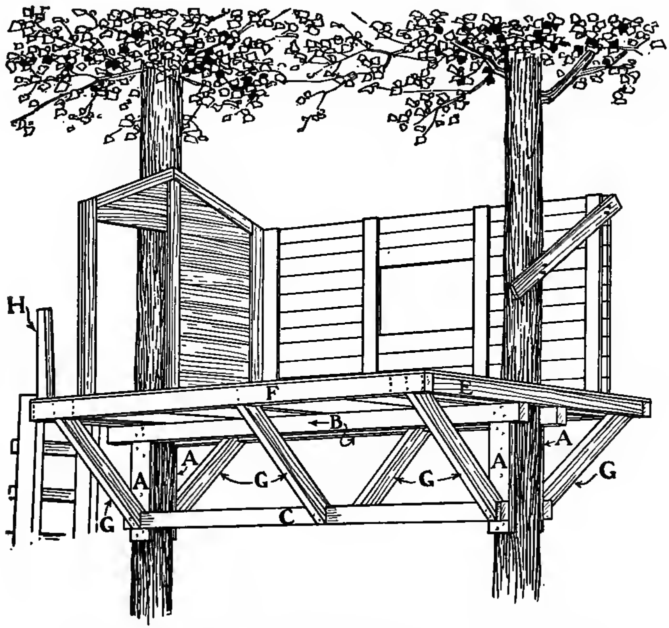


FIG. 536. — The Tree-Hut Platform, with Two Walls in Position.

of these, and be spiked to the trees, and the pieces *C* spiked to the bracket blocks *A* near their lower ends. Cut and fasten the block *D* between pieces *C*.

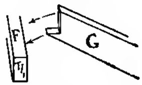
The Floor Joists should be laid on top of horizontal pieces *B*. One of these should be fastened on the outer face of

each tree, one on the inner face of each tree, and one or two in the space between. Then pieces *F* should be spiked to their ends (Fig. 536).

The Struts *G* should be cut of the right length to reach from pieces *F* to *C*, and should have notches cut in their ends for these pieces to fit in (Fig. 538). When these have been securely spiked in place,

Cut the Floor Boards and nail them to the joists.

FIG. 538.



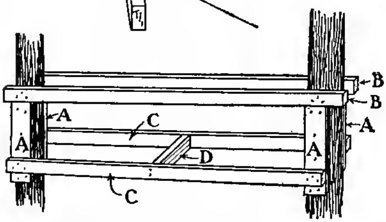


FIG. 537.

FIG. 537. — Detail of the Platform Supports.
FIG. 538. — Detail of Struts.

It is easiest to

Construct the Walls of the Tree-Hut in Sections, building them upon the ground, and then hoisting them into position by means of a rope thrown up and over an upper limb of one of the tree supports. Figures 539 and 540 show how the wall sections should be built up. You will see by these diagrams that the ends of the boards are nailed to board *battens;* also, that where there is to be a window, an extra batten is placed each side of the opening to nail the boards to. The battens on the side boards are set in 2 inches

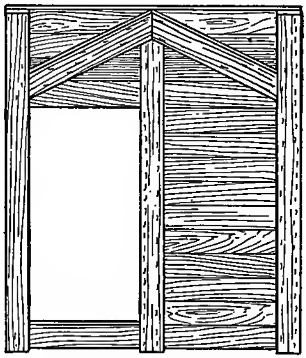


FIG. 539. — Batten the End Walls like this.

from the ends, as shown, because the ends of the side walls overlap the ends of the end walls.

Lay the battens flat upon the ground, at the proper distances apart, connect them temporarily with horizontal strips at top and bottom, and after checking up to see that they are exactly parallel, and that their corners are square, turn the frame over and nail the side boards to the other side. In the case of the end walls, build them up square as shown (Fig. 539); then fit in pieces at the proper angles for the pitch of the roof, and saw off the corners on a line with them. The bottom board of the end wall in which the doorway is located should be extended across the opening for a brace (Fig. 539), and be sawed off after the wall has been fastened in place. Use nails long enough to extend through the boards and the battens, and clinch them upon the inner face of the battens.

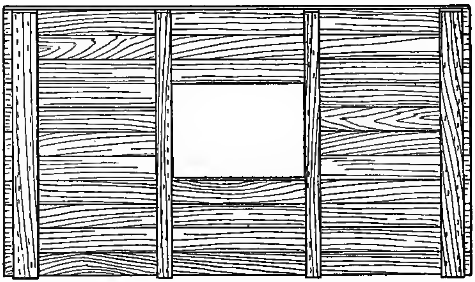


FIG. 540. — Batten the Side Walls like this.

Erecting the Walls. The two end walls may be set up in position, first, and be nailed to the end tree-supports; then the side walls may be set up and be fastened to them; or one end wall may be set up, then a side wall, then the second end wall, and then the second side wall.

Make a Board Roof, by fastening first one layer of boards

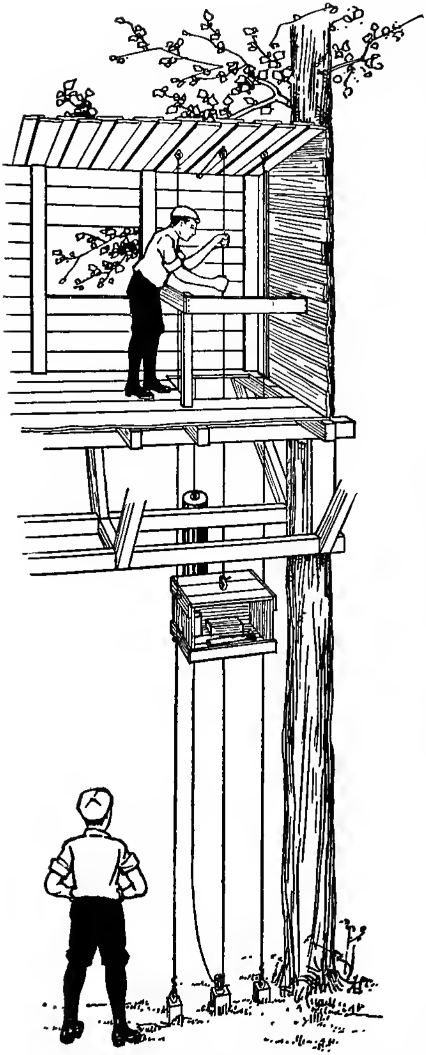


FIG. 544. — A Tree-Hut Dumb-Waiter.

in place, and then a second layer so as to lap the joints of the first layer, as shown in the detail of the workshop roof in Fig. 8, page 13. In place of the second layer of boards, you may tack a covering of tar-paper to the first layer boards.

The Window Opening may be made of the right size for an old window-sash; but if you cannot find a sash, a wooden shutter can be used for closing up the opening.

For the Door, batten together several boards in the manner shown for the workshop door in Fig. 24, page 26.

The post *H* (Fig. 536) is

A Newel-Post to steady oneself by when descending from and ascending to the tree platform, and

should be securely spiked to the platform supports.

A Dumb-Waiter can be put to excellent service in a tree-hut, and constructing it and operating it will afford its builder a great deal of fun. It will be useful for carrying up supplies, and if built before the hut is entirely finished may be used for hoisting the finishing materials.

Get a small packing-case for

The Dumb-Waiter Car. The top of this box will be the open front of the car, and it should have the board *A* (Fig. 546) nailed across it to keep small articles from dropping out. Find the exact center of both sides of the box, by drawing lines diagonally across them from corner to corner, and at each of these centers — the intersections of the diagonal lines — screw a screw-eye into the box (*B*, Figs. 545 and 546). Also screw two screw-eyes (*C* and *D*, Fig. 546) into each end of the box, one

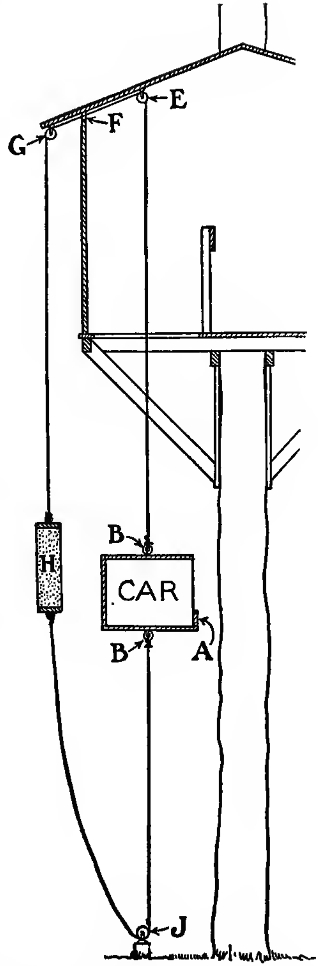


FIG. 545. — Section through Tree-Hut showing Dumb-Waiter Car, Cables, Pulleys and Counterbalance.

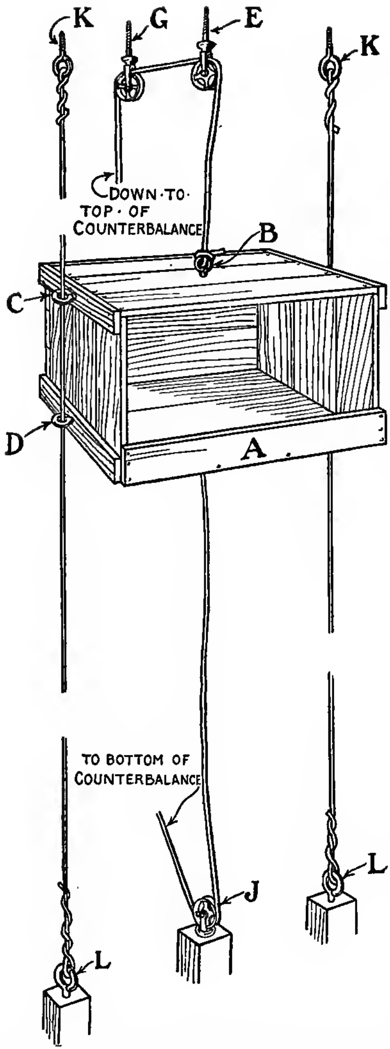


FIG. 546. — Details of Dumb-Waiter Car, Cables, Guides, etc.

directly over the other, and in line with screw-eyes *B*.

The Lifting Cables, for which strong clothes-line should be used, are fastened to screw-eyes *B*, and wire guides are provided for screw-eyes *C* and *D* to slide on.

The Shaft-Opening in the floor of the tree-hut is cut just enough larger than the car to allow plenty of clearance for it and the guides.

To get the right position for

The Cable Sheave *E* (a clothes-line pulley), in the roof of the hut, fasten the rope which you are going to use for a lifting cable to screw-eye *B* in the top of the car, and then, using the car as a plumb-bob, let it hang in the floor opening and hold the rope against the hut ceiling. Then shift the position of the rope

until the car hangs in the exact center of the floor opening. After screwing the sheave *E* into the roof boards at this point, bore a hole through the wall of the hut directly in line with it (*F*, Fig. 545), and screw the sheave *G* (a clothes-line pulley) into the roof at the extreme end of the *eaves* (see Fig. 545).

The Counterbalance for the Car (*H*, Fig. 545) is a section of 6- or 8-inch stove-pipe filled with earth or sand. Figure 547 shows how it is prepared. Cut the two circular pieces *I* of the proper diameter to fit in the ends of the stove-pipe, and screw a screw-eye into the center of each. Then slip one piece into one end of the stove-pipe, and nail the stove-pipe to it with 1-inch nails; fill the pipe with enough earth or sand to make it a trifle heavier than the empty car, and fasten the second wooden end in place.

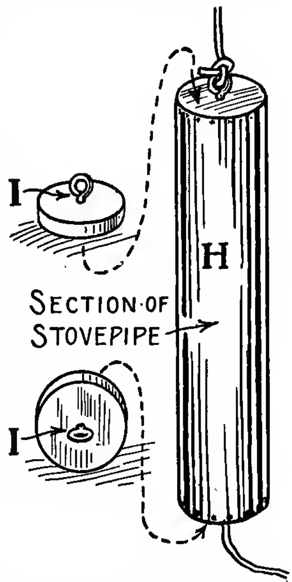


Fig. 547. — Detail of Counter-balance.

The Upper Lifting Cable should be of the proper length so that when the car is pulled up above the floor level, the counterbalance will hang clear of the ground.

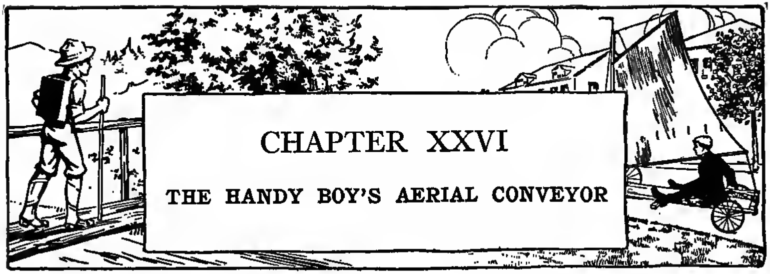
The Lower Lifting Cable, attached to the screw-eye in the lower end of the counterbalance, and to screw-eye *B* in the bottom of the car, is for the purpose of operating the eleva-

tor from the ground level. The sheave *J* (Figs. 545 and 546) should be screwed into a stake driven into the ground directly below the top sheave *E*, for this lower lifting cable to run through.

The Wire Guides are necessary to keep the car from swinging and twisting about. Almost any kind of wire will do for these. Fasten the two screw-eyes *K* into the roof of the hut, to fasten the top ends of the guides to, and the screw-eyes *L* into stakes driven into the ground, to fasten the lower ends to. The screw-eyes must be located very carefully, so that the guides will be perfectly vertical. Pull the wires as tight as you can, and then, after twisting the ends upon themselves, use a spike for a lever to twist them tighter.

Build a Railing around the elevator opening for protection when the car has been lowered. If this is built as shown in Fig. 544, the car can be reached from beneath the top rail.

A dumb-waiter similar to this one may be built from the ground to a second-story window or porch, or to a tree platform, with the same plan of construction.



CHAPTER XXVI

THE HANDY BOY'S AERIAL CONVEYOR

When two boys in our neighborhood rigged up a toy conveyor between their homes, the idea was at once seen to be productive of so much fun that half a dozen other boys immediately installed similar conveyors between their homes. Most of these operated from upper-story windows. Some of the little baskets, or cars, were pulled back and forth along a wire stretched taut between two windows by means of cords attached at either end of the cars; and others were operated by heavy cord or light rope run over pulleys after the manner in which pulley clothes-lines are put up. At first most of the cars were made just large enough to hold written messages; then one of the boys conceived the idea of making a larger car and sending a glass of water to his friend, and his success led another lad to send a dish of ice-cream across the street to his partner; so you see the toy served more purposes than one.

Perhaps you have established a telephone line between your house and that of your chum, or each of you has a wireless telegraph outfit by which you communicate with one another; but even so, you cannot exchange a book, or

return or borrow a baseball glove by either of these, though it is entirely possible to do so with a toy conveyor.

How the Aerial Conveyor Operates. Figure 548 shows one of the simplest and most satisfactory forms of aerial conveyors. You will see by this illustration, and the detail diagrams of Figs. 549 to 552, that a single wire extends from one point of communication to the other, and that the car runs by force of gravity — the end from which the car is started being hoisted enough higher than the opposite end to give the wire the necessary pitch. Figures 549, 550, and 551 show the details for making.

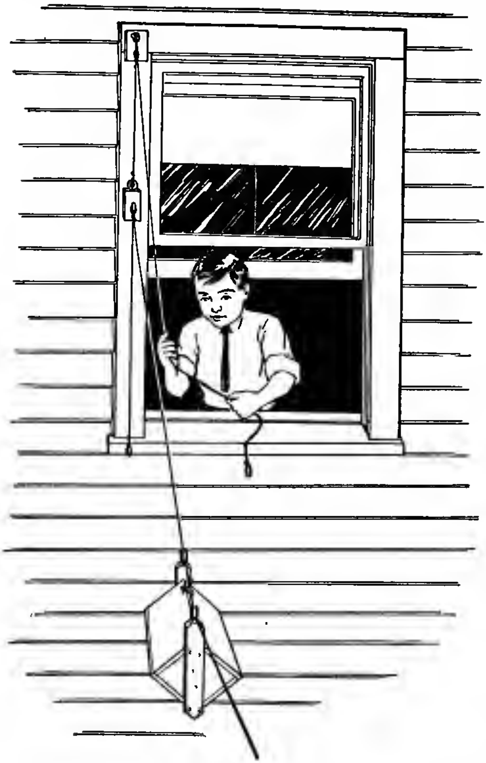


Fig. 548. — A Handy Boy Aerial Conveyor.

The Device for Raising and Lowering the Ends of the Wire. Screw or nail the block *A*, into which you have screwed a screw-eye *B* and a pulley *D* in the positions shown, to the

casing upon the outside of the window (Fig. 550); and screw a second screw-eye into the window-sill directly under *B* (*C*, Fig. 549). Cut another small block (*E*, Fig. 551), screw two screw-eyes into one face — one directly above the other (*F*, Fig. 551), and screw a third screw-eye into the opposite face (*G*, Fig. 551), and a fourth into the top (*H*, Fig. 551). Then fasten one end of a piece of heavy wire to screw-eye *B* in block *A*, and after running the other end through the eyes *F* in block *E*, slip it through screw-eye *C* in the window-sill, pull it taut, and fasten it.

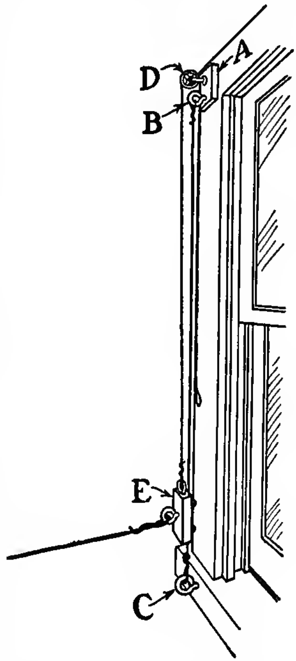


FIG. 549. — The Device for Raising and Lowering the Conveyor Cable.

The Cable along which the Car Travels is attached to screw-eye *G* (Fig. 551). This wire must be left slack enough to permit raising its ends. You will find that it will sag to some extent, and probably enough to serve the purpose.

The Lifting Rope. Tie a piece of clothes-line to screw-eye *H* in the top of block *E*, run it up and over the pulley *D*, and bring it down to within a foot or so of the window-sill (Fig. 549). This is the lifting rope. A loop made in the free end can be slipped over a nail in the window-casing, to keep the rope within easy reach.

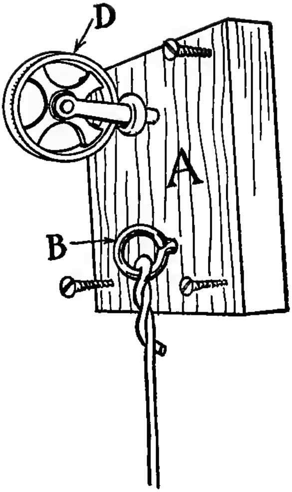


FIG. 550.

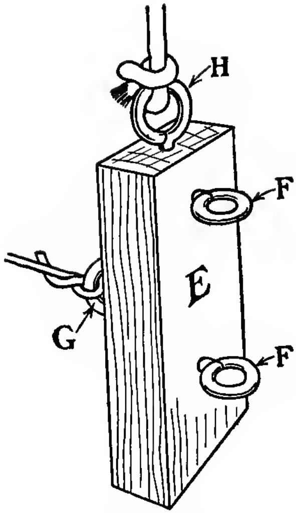


FIG. 551.

FIGS. 550 and 551. — Details of Device for Raising and Lowering the Conveyor Cable.

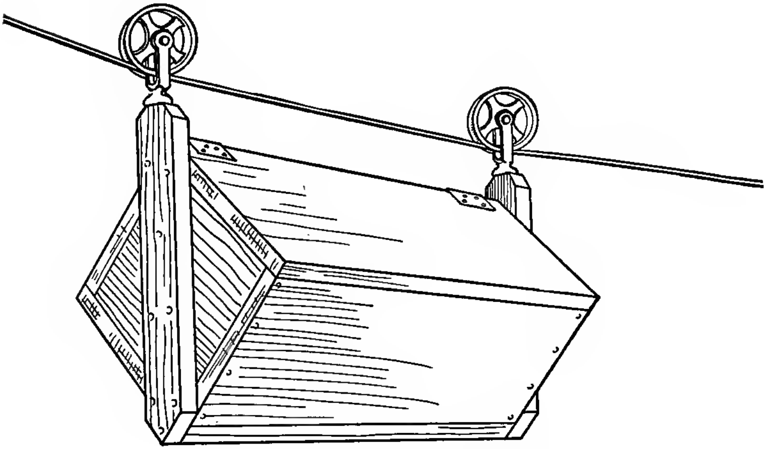


FIG. 552. — The Conveyor Car.

A Neat Form of Conveyor Car is shown in Fig. 552. Any small grocery box may be used for this. Cut two strips of wood to fit diagonally across the ends (*I*, Fig. 553), and fasten the cover in place with a pair of iron or leather hinges. Then screw a clothes-line pulley into the end of each upright *I*, and the car will be completed.

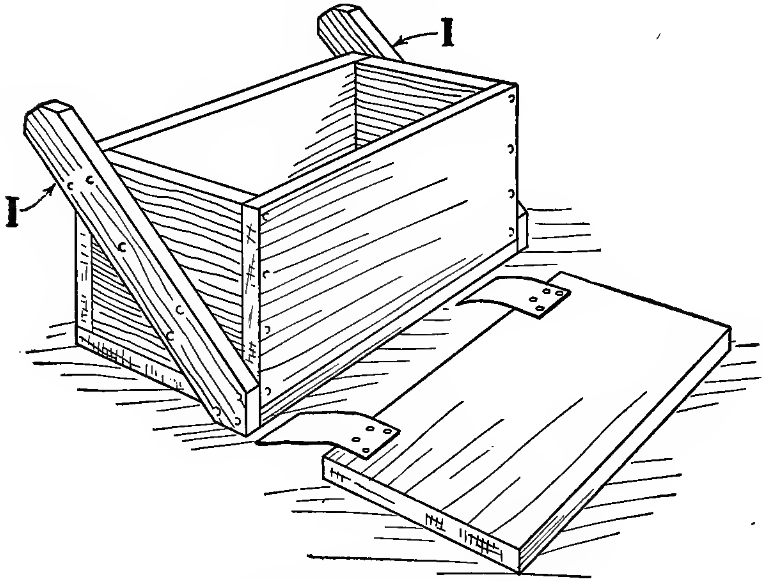
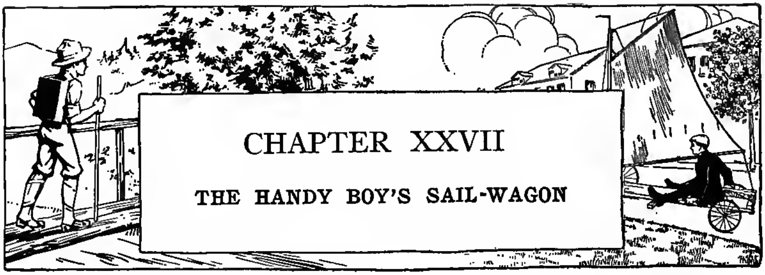


FIG. 553. — Detail of Conveyor Car.



CHAPTER XXVII

THE HANDY BOY'S SAIL-WAGON

WHEN the ice has broken up, and while the lakes, ponds, and streams are sluggish and unfit for either boating or ice yachting, there remains the home-made land yacht for the boy whose hobby is sailing, to tide over the time until he can make use of his sailing canoe or sailboat. And for the boy who doesn't have an opportunity to sail a boat, the land yacht is a fair substitute and will afford him and his companions an unlimited amount of fun, coasting along the streets and vacant property.

A sail-wagon can be built quickly, as its construction differs slightly from that of a simple coasting wagon. The wagon illustrated in Fig. 554 is steered from the rear, just as the rudder of a boat is controlled. This makes it necessary to turn the wagon around rear end to, so the solidly fastened pair of wheels will be at the bow and the pivotal pair of wheels at the stern.

The Wagon-Bed. Get a pair of planks 2 inches thick, 10 or 12 inches wide and about 8 feet long, for the wagon-bed, and two pair of wagon, velocipede, or baby-carriage wheels for the wheels. Figure 555 shows a plan view of the under side of the wagon-bed with the wheels in place.

The Bow Wheels have a spread of 4 feet, to give the wagon sufficient stability, which will make it necessary to procure a long axle for these wheels. If you have the axle

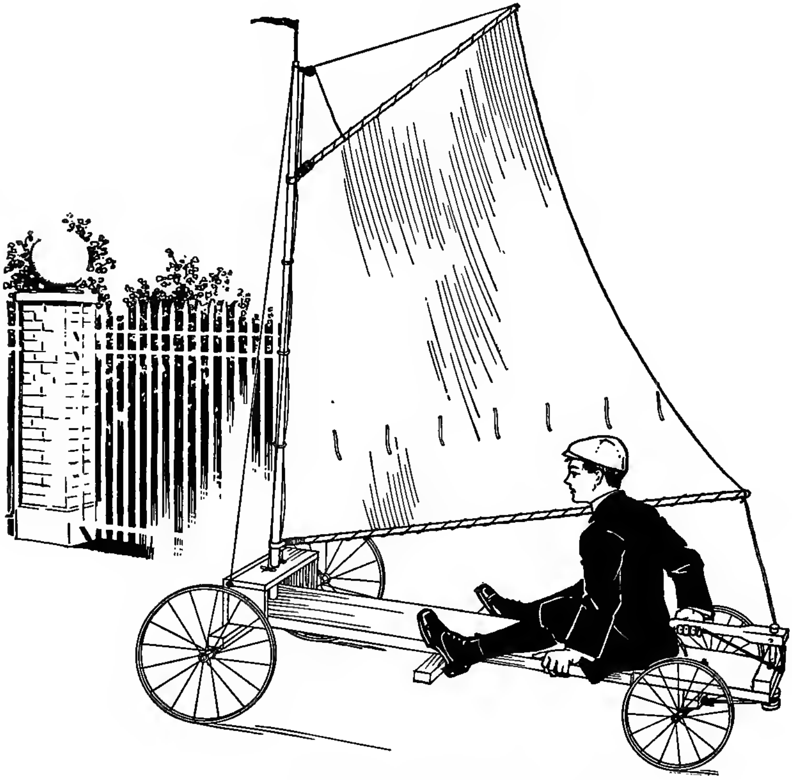


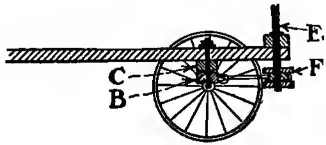
Fig. 554. — The Handy Boy's Sail-Wagon.

that belongs to the wheels, buy a 4-foot length of *gas-pipe*, and take it and the axle to a blacksmith or machinist. Have him cut the iron axle into halves, slip one half into each

end of the piece of gas-pipe, as shown in Fig. 557, and rivet or bolt them in place. Cutting the axle, and drilling and riveting the halves to the gas-pipe will not cost more than 25 cents. With staples, fasten the gas-pipe axle to a 2-by-4

FIG. 557

FIG. 556.



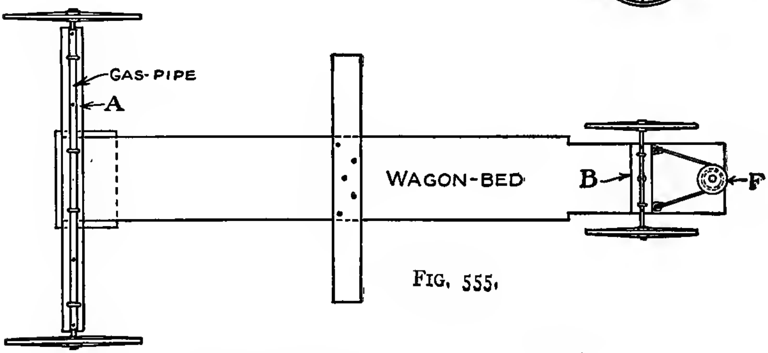


FIG. 555.

FIG. 555. — Plan of Under Side of Wagon-Bed.
FIG. 556. — Section through Stern.
FIG. 557. — The Bow Axle.

axle (*A*, Fig. 555), and screw or nail this wooden axle to the wagon-bed at the extreme end.

The Stern Wheels require a 2-by-4 axle (*B*, Figs. 555 and 556), and a crosspiece *C* of the same size (Fig. 556). Nail crosspiece *C* to the wagon-bed 12 inches from its stern end. Then bore a ⅝-inch hole through the center of the length of axle *B*, and another through the center of crosspiece *C* and the wagon-bed, and bolt the axle to the wagon-bed

with a 5/8-inch carriage-bolt. Fasten the iron axle to the wooden axle with staples.

The Tiller, Tiller-Post and Connections are shown in detail in Fig. 558. Whittle one end of the tiller stick (*D*) round for a handle, and bore a hole through it near the other end for the post (*E*), which may be a piece of broom-handle. Make the three wooden disks which form the *spool* (*F*) out of hard wood, fasten them together, and screw to the lower end of post *E*. Nail a crosspiece to the top of the stern end of the wagon-bed, as shown in Fig. 554, and then bore a hole through this and the wagon-bed large enough to stick the tiller-post through. Slip the post far enough into the hole so spool *F* will be on a level with the wheel axle, and drive an iron pin through a hole in the post to keep it from dropping farther, as shown. Fasten the tiller stick to the top of the post with another iron pin.

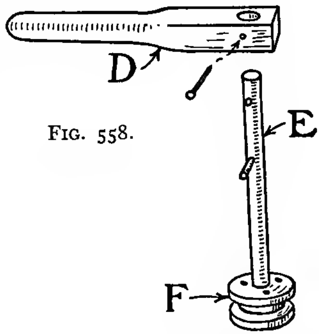


FIG. 558.

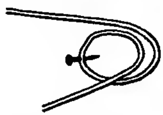


FIG. 559.

FIG. 558.—Detail of Tiller and Tiller-Post.

FIG. 559.—Loop in Rope Connecting Tiller-Post and Axle.

Get some strong manila rope with which to connect the tiller-post and axle ends, loop it as shown in Fig. 559, slip the loops over the spool on the tiller-post, and tie its ends to a couple of screw-eyes screwed into the wooden axle.

Drive a nail through one side of the loop, as in Fig. 559, and into the spool, to keep the rope from slipping.

If the plank of the wagon-bed is as wide as the iron axle, it will be necessary to saw away a strip on each side edge, as shown in Figs. 554 and 555, so the wheels can turn. The arrangement does not permit of sharp turns, but this may be made possible by either extending the stern axle farther each side of the wagon-bed, or by mounting the wheels upon a deep wooden axle that will permit them to turn under the wagon-bed.

The Mast-Step is made as shown in Fig. 560. It should be about 8 inches high and 8 inches wide. The board *G* is nailed to the front edges of the step for a brace. Nail the ends of the step to the edges of the wagon-bed.

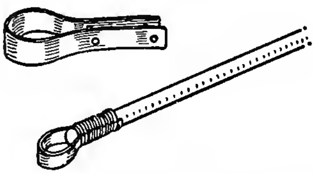


Fig. 562. — Loop on End of Gaff and Boom.

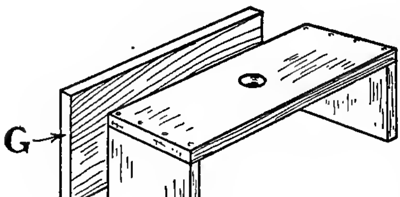


Fig. 560. — Mast-Step.

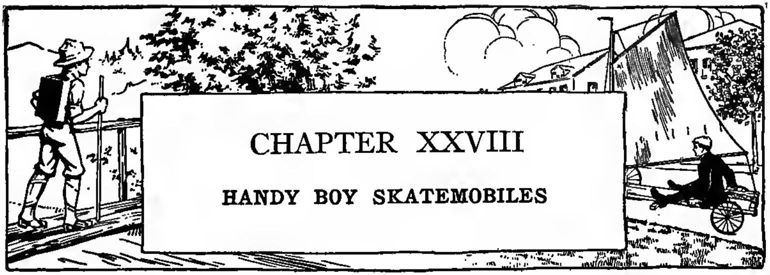
Fig. 561. — Cleat.

An Excellent Mast for the sail-wagon may be made out of a rug-pole, but, lacking this, cut a pole about 2 inches in diameter and 8 feet long. Bore a hole through the center of the mast-step, and another through the wagon-bed plank, to receive the bottom of the mast. The lower hole should be

a trifle forward of the upper hole, to give a slight *rake* to the mast. Brace the mast with rope *shrouds* fastened to its top and to screw-eyes at each end of the mast-step.

A Cat-Boat Rig is shown upon the sail-wagon illustrated, but another form of sail may be substituted if you wish. The *boom* for the cat-boat rig should be about 8 feet long, and the *gaff*, or top pole, about 5 feet long. Curtain-poles will serve excellently for these if you can procure them. The mast end of each should have a loop of strap-iron fastened to it with screws and wire, as shown in Fig. 562, to fit over the mast.

Unbleached muslin is good material for the *sail.* Make this 5 feet along the *luff*, or edge along the mast, 9 feet on the *leach*, or outer edge, and the respective lengths of the gaff and boom along the *head* and *foot.* Curtain-pole rings, or loops of heavy wire, make satisfactory *rings*, a clothes-line pulley is all right for a *block* for the mast-top, and a light-weight rope is best for *sheets* and *halyards*. *Cleats* on which to fasten these ropes may be made as shown in Fig. 561.



CHAPTER XXVIII

HANDY BOY SKATEMOBILES

The skatemobile is the latest idea in home-made wagons, and is immensely popular with every boy who has built one. Devised by a handy boy of foreign parentage, living in one of the poorer districts of Chicago, the idea quickly spread to other neighborhoods, then from the city to the suburbs, and barely had a week passed after its first appearance before the wagon was in evidence everywhere within a radius of fifteen miles.

Young Toney, the inventor, owned but a single roller-skate, and of course that skate was of no use for roller-skating; so he set to thinking, and, by bringing his inventive genius into action, evolved the skatemobile. Toney at once discovered far greater possibilities for fun in his home-made wagon than roller-skating afforded, and the boys who saw him scooting swiftly along the sidewalk in his novel "machine" were not slow to recognize the fact. The author has had the opportunity to tell boys of other cities, through his newspaper articles, all about this wonderful little machine, and now the skatemobile has become almost as popular elsewhere as in the city of its birth.

The rapid growth in the manufacture of skatemobiles

FIG. 563.—AT THE START OFF. A RACE OF THE LINCOLN PARK SKATEMOBILE CLUB.

FIG. 564.—SKIDDING AT THE TURNS MAKES SKATEMOBILE RACING ALL THE MORE THRILLING.

naturally suggested the formation of Skatemobile Racing Clubs, with the result that neighborhood races quickly became the reigning after-school pastime. Skatemobile racing is most exciting, more so than you can believe until you have seen one. The start is made upon the drop of a handkerchief, as shown in Fig. 563, the course lies around a city block or square, policed by boys to keep it clear, and the finish is made across the starting line. The most thrilling part of the race is at the turns (Fig. 564), where the "machines" skid almost as spectacularly as do the machines in a real auto race, and it is here where the skill of the drivers is put to the test.

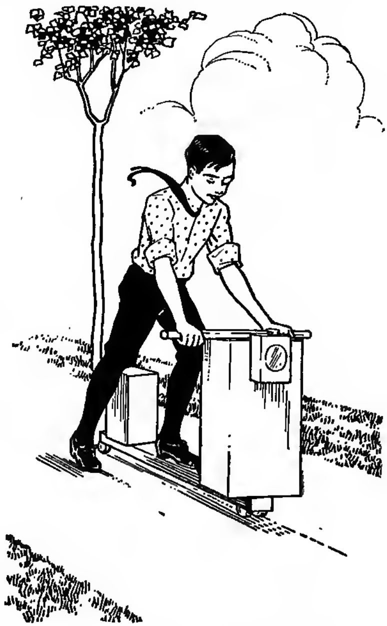
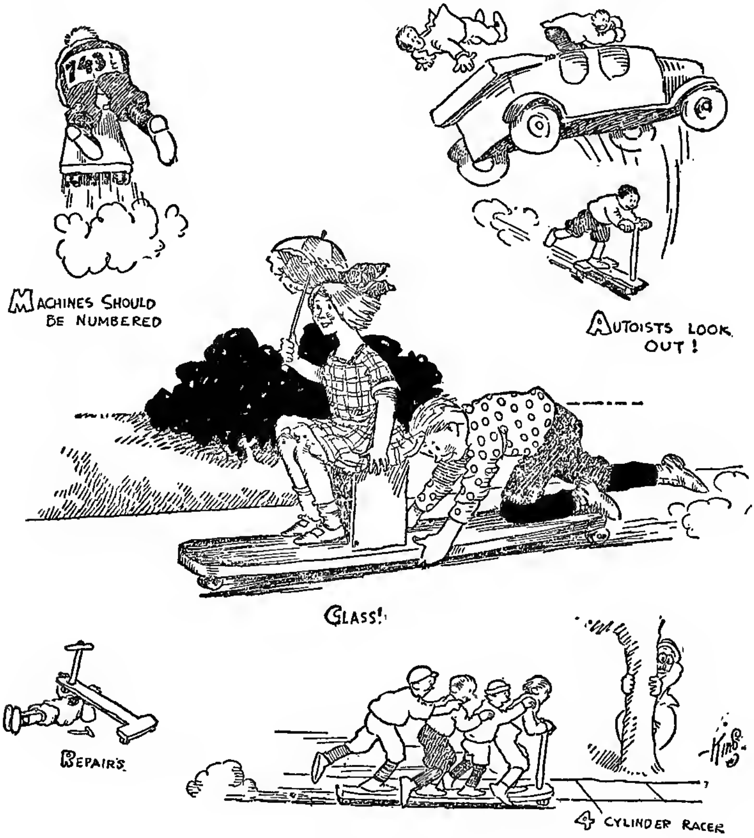


Fig. 565. — A Popular Type of Skatemobile.

As only one skate is necessary for a skatemobile, you can build two different types with your pair — say one of the simplest forms of racing car, and one of the more elaborate forms, with headlight, side-lamps, and a rear seat, for a passenger car.

It does not injure your roller-skate in the least to use it for a skatemobile, and it can be detached from

the machine and restored to its original form with a few minutes' work. The front wheels of the skate are fastened



Courtesy of "The Chicago Tribune"

Skatemobile Suggestions.

to the front end of the machine, and the rear wheels to the rear end.

A Popular Type of Skatemobile is shown in Fig. 565, and details of its construction are shown in Figs. 566 to 568.

For the Reach-Board, or bottom platform, a piece of 2-by-4 is best, but lacking material of this thickness, many boys use a board 1 inch thick and 6 inches wide. It should be about 3 feet long.

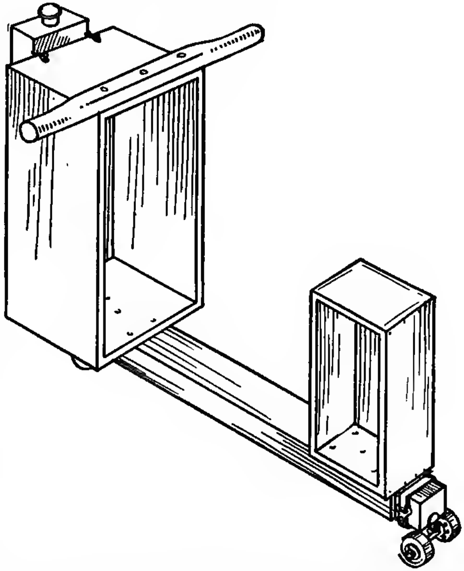


FIG. 566. — View of Skatemobile from the Side. The "driver" sits upon the small box when coasting.

To Separate the Skate Wheels, it is only necessary to loosen the nut on the screw provided for adjusting the length of the skate, and then pull the steel frame apart. Figures 567 and 568 show

How the Skate Wheels are Attached. The toe end of the frame is clamped to the forward end of the reach-board, and the rear por-

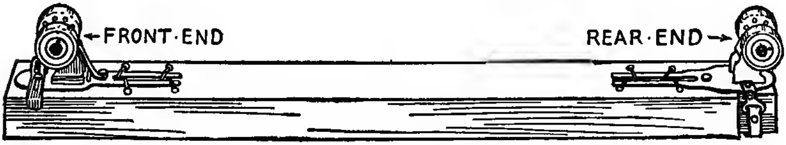


FIG. 567. — How the Roller-Skate Wheels are Attached.

tion of this is secured with nails driven into the reach-board and bent over the metal. The heel portion of the frame is held to the reach-board by means of the skate-strap and bent-over nails (Fig. 568). In order to make the heel set flat, it is necessary to cut away the side edges of the reach-board, as shown in Fig. 567, so the projecting tips of the heel plate will clear the sides.

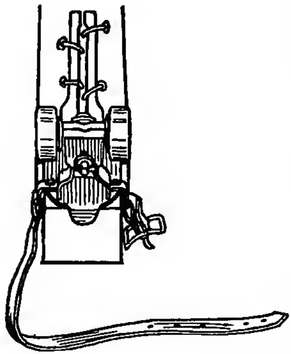


FIG. 568. — Attachment of Heel End of Skate.

The Hood, or front of the skatemobile, is a grocery-box about 24 inches long, 12 inches wide, and 10 inches deep, and is securely nailed to the reach-board.

The Handle-Bars are nailed across the top of the hood. Use a piece of a curtain-pole, broom-handle, or a stick shaped round at the ends, about 24 inches long, for these. In nailing this stick to the box, use nails long enough to drive through and clinch on the under side of the box.

The short box on the rear of the reach-board (Fig. 566) is **A Seat** which many boys add for coasting. After pushing the car from a standing position until it has attained enough momentum to carry it a considerable distance, the driver jumps aboard and, holding firmly to the handle-bars, drops back on to the seat.

Several Other Makes of Skatemobiles are shown in Figs. 569 to 572.

FIGS. 569-572.—SEVERAL MAKES OF SKATEMOBILES.

A Headlight for the skatemobile can be made from a small varnish-can (Figs. 573 to 575). One of these can be procured for the asking from a painter. Mark out a circular opening upon one face of the can with a pencil, and cut it with a can-opener (Fig. 573). Then mark a larger square opening upon the opposite face and cut it in the same way (Fig. 574). Get a small piece of glass for the front of the headlight — a 4-by-5 camera plate will do — and fasten

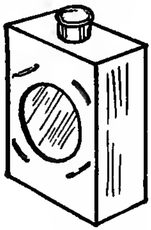


Fig. 573.

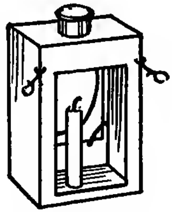


Fig. 574.

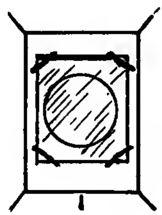


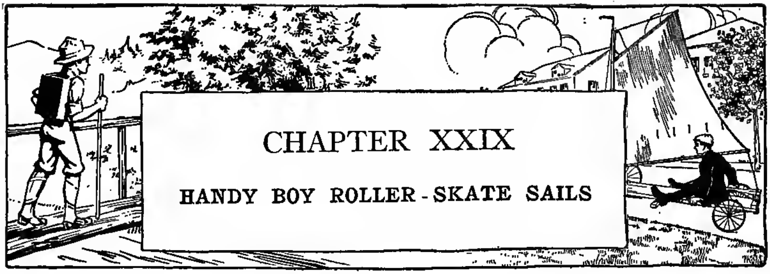
Fig. 575.

Figs. 573–575. — Details of Varnish-Can Headlight.

it to the inside of the can by means of wires passed diagonally across the corners and through the can, as shown in Figs. 573 and 575. Drive a large carpet-tack through the bottom of the can on to which to stick a candle.

Figure 574 shows how hooks made of wire are fastened to the back of the headlight, and Fig. 566 shows how these hook over nails driven into the top of the box hood, near the front edge. The spout of the varnish-can provides a splendid chimney for the headlight.

A lard-pail will make another good form of headlight.



CHAPTER XXIX

HANDY BOY ROLLER-SKATE SAILS

HAVE you boys ever thought of the idea of making a sail for roller-skate sailing along the sidewalk? Roller-skate sailing is almost as much fun as sailing on ice-skates, and with a fair wind it is possible to spin along the pavement at a delightful speed. The common forms of ice-skate sails can be used, but they should be of smaller proportions so they can be handled easily.

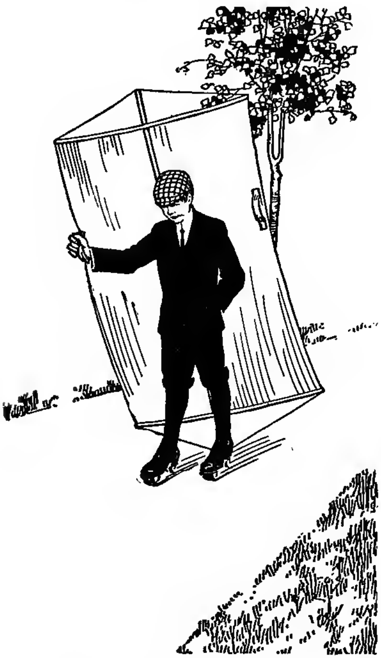


FIG. 576. — Sailing with a Square Roller-Skate Sail.

Figure 576 shows a boy using a square-shaped sail, and Fig. 580 shows a triangular-shaped sail. The former has a larger area, and the latter is the easier to handle on this account.

The Square Sail illustrated in Fig. 577 is 3 feet wide and 5 feet long. Cut the top and bottom *spars A* 3 feet long, and the center *spreader B* 6 feet 6 inches long. Almost any light-weight closely woven cloth that you can find will do for

The Sail Covering. Perhaps you can get an old sheet. Cut the sail cloth so the *selvage* will extend along one edge, and hem the cut edge to keep it from raveling. Tack the top and bottom to spars *A* (Fig. 578).

The Rope Stays, which hold the sail to the spreader, are tied to nails driven into the spars and the spreader. Drive a nail into each end of all three sticks, and drive a nail into spreader *B* about 6 inches from each end (Fig. 579), and one into spars A at their centers (Fig. 578). Tie one of the rope stays to each center nail of spars (*A*, Fig. 578), and another to each end nail of spreader *B* (Fig. 579).

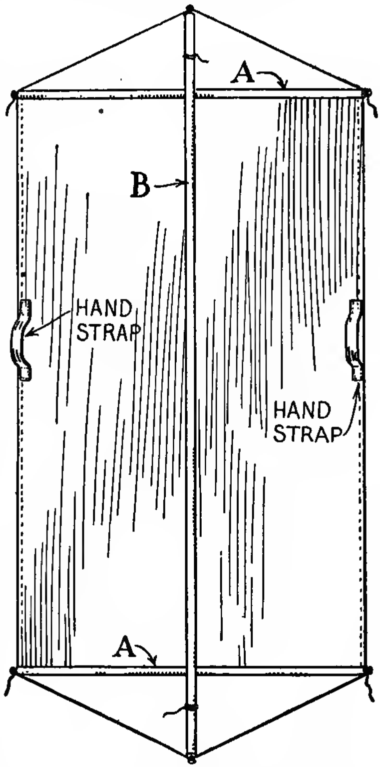


Fig. 577.—A Square Roller-Skate Sail.

To Fasten the Sail to the Spreader, first tie the rope stays on spars *A* to the nails on the side of the spreader, then run the ropes on the spreader ends to the nails on the ends of spars *A* and tie them.

The Hand-Straps sewed to the face of the sail cloth may be made of braid or pieces of cloth folded into several thicknesses.

The Method of Holding the Sail when the wind is from in back of you is shown in Fig. 576. The left hand grasps

FIG. 578.

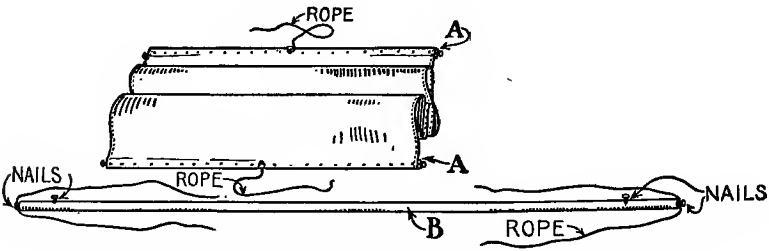


FIG. 579.

FIG. 578. — The Square Roller-Skate Sail Detached from Spreader.
FIG. 579. — The Spreader.

the spreader, and the right hand extended spreads out the sail sideways by means of the hand-strap. The sail can be lifted around to either side, and the positions of the hands reversed, according to whichever direction the wind is blowing from, in the same way that you would handle the sail of a sailboat.

The Three-Cornered Sail shown in Fig. 580 requires two spars — *C*, 5 feet long, and *D* 3 feet 4 inches long. The end of the spreader spar (*D*) slips into a socket on spar *C*,

FIG. 582 FIG. 581.

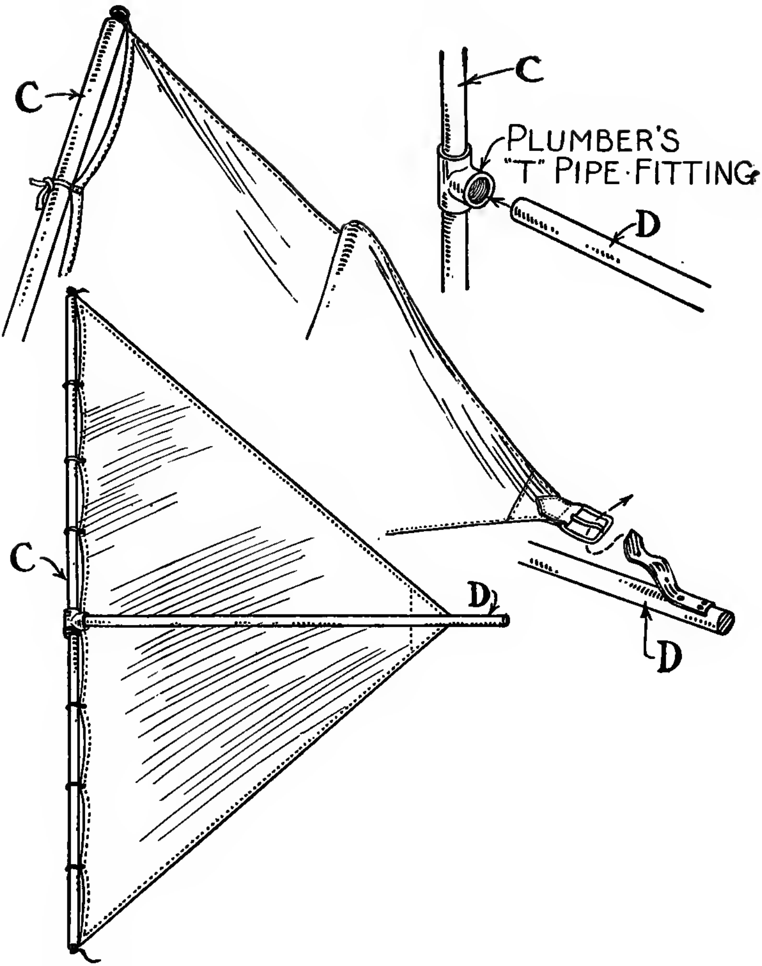


FIG. 580.

FIG. 580. — A Three-Cornered Roller-Skate Sail.

FIG. 581. — The Spar Connections.

FIG. 582. — How the Sail Cloth is Fastened to the Spars.

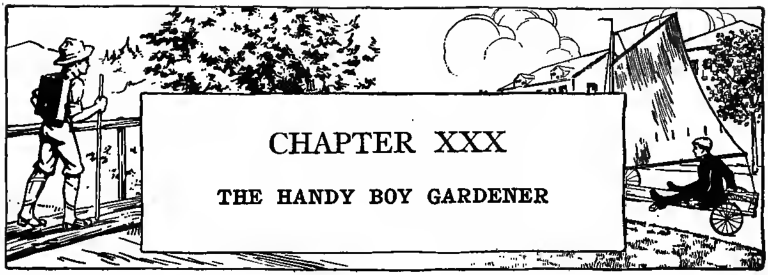
and by detaching the sail, the sticks can be separated and rolled up in the cloth in as compact a form as the other sail.

For the Connecting Socket, go to a plumber and get a *T pipe fitting* (Fig. 581). He can probably find one with broken threads about his shop, which will be of no use to him, yet serve your purpose exactly. Cut the vertical spar (*C*) so the "T" fitting will fit it snugly, and drive the "T" along the spar to the exact center.

The Sail Cloth edges that haven't a *selvage* should be hemmed, and the corner which is fastened to spreader *D* should be reënforced with a piece of cloth as indicated by dotted lines in Fig. 580. The sail may be tacked along spar *C* in the same way that the sail in Fig. 577 is fastened, or it may be *lashed* to the spar like regular sails are lashed (Fig. 580). For lashing the sail, you must either set in metal *eyelets* along the edge of the sail for *tapes* to run through, or sew tapes directly to the cloth. In either case that edge of the sail must be reënforced by sewing a strong piece to it (Fig. 582). To the point of the sail which fastens to the spreader, sew a buckle (Fig. 582). Then the sail can be pulled taut and be buckled to a strap on the spreader. If you cannot find a buckle, you can fasten a rope to the corner of the sail, instead, and tie it to a nail driven into the end of the spreader, which will serve the purpose if you tie a knot that will not slip and yet be easy to untie.

The Method of Holding the Sail is somewhat similar to that illustrated for the square sail. Spar *C* is held with one

hand and supported on the shoulder, and the spreader *D* is held with the other hand. The sail is shifted from shoulder to shoulder, and the hand holds reversed, with a change in the direction of sailing, according to which way the wind is coming from.



CHAPTER XXX

THE HANDY BOY GARDENER

EVERY handy boy gardener needs a wheelbarrow for carrying earth and fertilizer, removing rubbish, and various other garden work, and lacking one, the first thing he should do is provide himself with

A Home-Made Wheelbarrow like that shown in Fig. 583. This is a barrow designed for practical purposes, and is

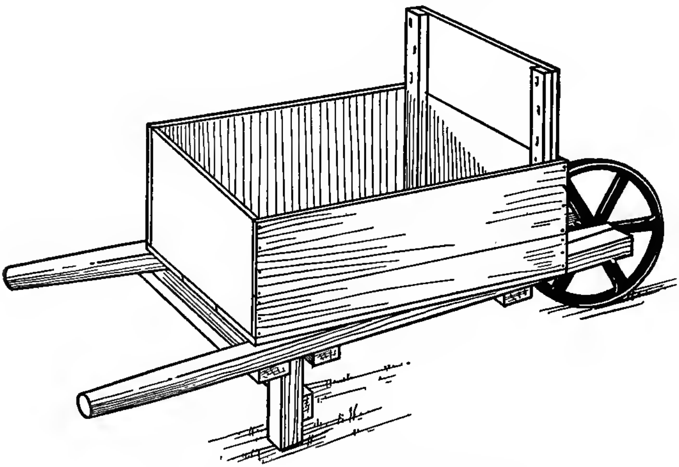


FIG. 583. — A Home-Made Wheelbarrow.

substantially made. And as the model from which the il-

lustration was made was built in less than one hour's time, you will see it was quite simple to put together.

An 11-inch cast-iron grooved *sheave*, or pulley wheel (Fig. 588), was used for

The Barrow Wheel, and served the purpose excellently. One of these can usually be purchased at a hardware store. A wheel from a broken wagon may be used instead, but of course the narrowness of its rim makes it less desirable for running over soft soil. Lacking a wagon wheel, a third form of wheel which can be used is

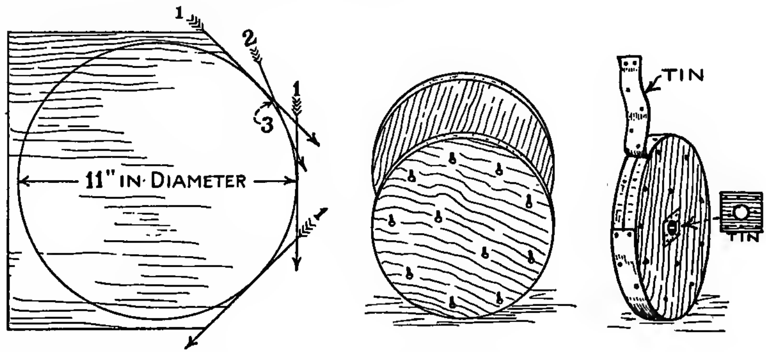


FIG. 584. FIG. 585. FIG. 586.
FIGS. 584–586. — Details for Making a Wooden Wheelbarrow Wheel.

A Wooden Wheel, made as shown in Figs. 584 to 586. This wheel is made in two pieces. First describe two circles 11 inches in diameter upon a 12-inch board 2 feet long, and saw them apart; then saw off the four corners of each piece close to the line of the circle, as indicated by the arrows marked 1 in Fig. 584, then the eight corners thus produced, as indicated by the arrow marked 2 in the dia-

gram, and then the sixteen small corners marked 3. The wheel pieces will then require only a little trimming with a chisel or wood-rasp to make them perfectly round, and a little rubbing with sandpaper to make them smooth.

Nail the two wheels together, with the grain crossed as shown in Fig. 585; then bore a ⅝-inch hole through the

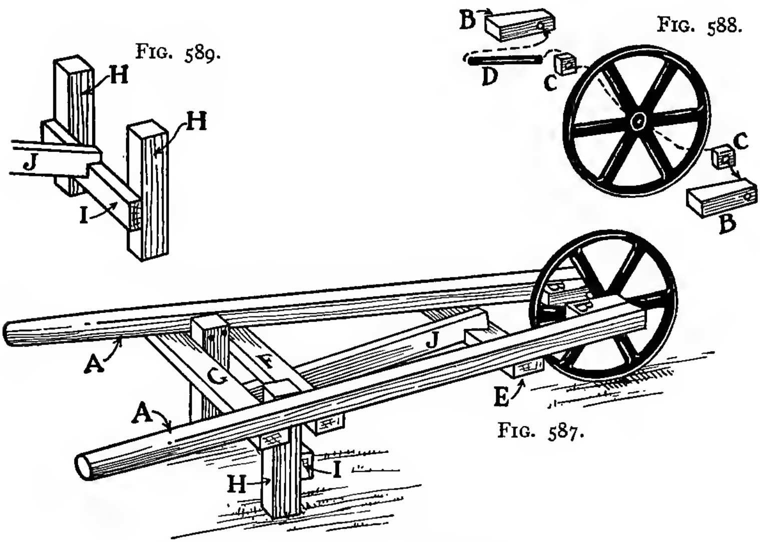


FIG. 587. — Framework of the Wheelbarrow.
FIG. 588. — An Iron Wheel, Axle and Bearing Blocks.
FIG. 589. — Detail of Wheelbarrow Legs and Braces.

center of the wheel and fasten to each side a small piece of tin with a ⅝-inch hole cut through the center, for *bearing plates* (Fig. 586). Bind the edge of the wheel with strips of tin, as shown.

The Framework of the Wheelbarrow is shown in Fig. 587,

and Fig. 590 shows a plan view of the under side of the framework with the principal dimensions for cutting and assembling the different parts. The *handle-bars A* can be prepared by ripping a 4-foot length of a piece of 2-by-4 in half, which will make them about 1¾ inch thick by 1¾ inches wide. On the handle ends of the bars, round off the edges for a distance of about 12 inches, using a draw-knife, plane, or jack-knife for the purpose.

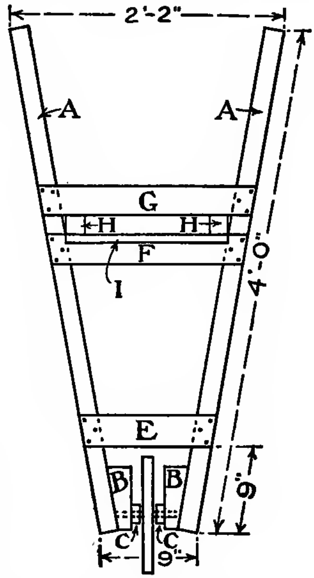


FIG. 590. — Plan of Under Side of Wheelbarrow Framework.

The *bearing blocks B* (Figs. 587, 588, and 590) support the ends of the wheel axle (*D*, Fig. 588), and are nailed to bars *A*. One side of each should be cut to the angle at which bars *A* are set, so the opposite face will be parallel to the wheel (Fig. 590). To get the correct angle, place the two bars upon the floor with the ends the distance apart shown in Fig. 590; then you can easily find what the measurements for the blocks should be. Bore a hole through each block about 1 inch from the bow end for the axle to fit in.

The *wheel axle* must be fastened in place before the connecting strips *E*, *F*, and *G* are fastened to bars *A*, and in doing this care must be taken to *center* the wheel; that

is, it must be placed so as to line up with the center of the space between the handle ends. If blocks *B* are made of identical shape and size, with the axle hole bored correctly, there will be no difficulty; but as there may be a little variance in these it is a good plan to assemble all parts temporarily, first, and find out whether they fit properly.

Fasten the connecting strip *E* to the bars 9 inches from the forward ends, strip *G* at a distance away equal to the length of the barrow box, which should be about 24 inches, and strip *F* 1½ inches from *G*. It is easiest to take strips that are a little longer than is necessary, nail them in place, and then saw off their ends flush with the sides of bars *A*.

The detail of

The Legs is shown in Fig. 589. Cut the short uprights *H* 9 inches long by 1½ inches wide, by 1½ inches thick, and fasten them together with the crosspieces *I*, which should be of the proper length so the legs will set against bars *A*, between strips *F* and *G* (Fig. 590). The ends may be trimmed off on one side so as to fit the angle of the bars, but a small triangular wedge may be driven in to fill the space,

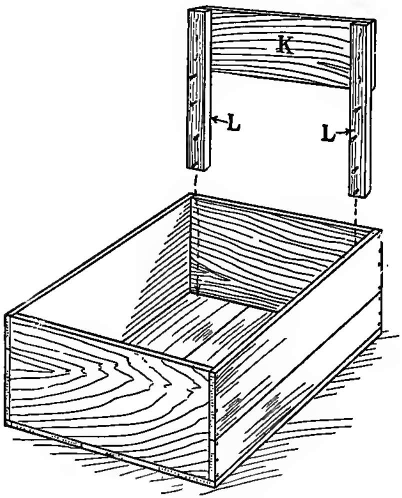


FIG. 591. — Detail of the Wheelbarrow Box.

instead. Nail the leg ends to the handle-bars, then brace them with the diagonal strip *J* cut to fit between the cross strips *E* and *I* (Figs. 587 and 589). Notch the ends of the brace to fit over *E* and *I*.

The Wheelbarrow Box is made of a grocery box about 9 inches deep, 18 inches wide, and 24 inches long. Re-nail any boards that show signs of coming loose; then, to increase the height of the box at the front, cut a piece of 8-inch board equal to the inside width of the box (*K*, Fig. 591), and by means of the two battens *L* fasten it in place as shown in Fig. 583.

Remove the paper labels from the box, then apply a coat of paint to all parts.

The Umbrella Bower shown in Fig. 592 makes a splendid support for morning-glory, wild cucumber, and Madeira vines. A worn-out umbrella which is past repair should be used. If any ribs are broken, it is a simple matter to bind a piece of heavy wire to them, so as to stiffen them; and if the connections have rusted through, they may be wired back into place well enough to serve your purpose.

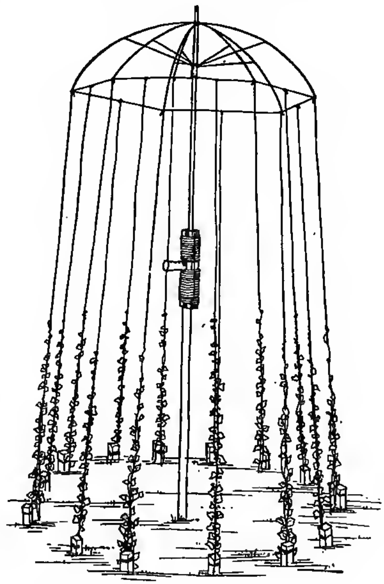


FIG. 592. — An Umbrella Bower.

For the lower part of the support get an old broom. Instead of sawing off the handle above the straw, cut the wire binding and unwind the wire, so as to preserve the full length of the handle. Then cut two blocks of wood 10 or 12 inches long, and by means of them and cord or wire, splice the broom-handle and umbrella-handle together.

Set the lower end of the broom-handle into the ground in a spot in the garden or on the lawn suitable for a vine rack. Run a cord around the ends of the umbrella-ribs, slipping it through the eye of each rib; then tie a piece of cord to this cord, at each rib, and another in the center of each space between (Fig. 592), and tie the other end of these cords to stakes driven into the ground directly in line with the points at which they are tied above, but about 6 inches farther away from the broom-handle.

Transplant your morning-glory shoots, or whatever species of vine you wish to have run over the frame, beside the stakes, and entwine the small tendrils around the strings to give the vines a start. The vines mentioned on the preceding page grow rapidly, and by carefully

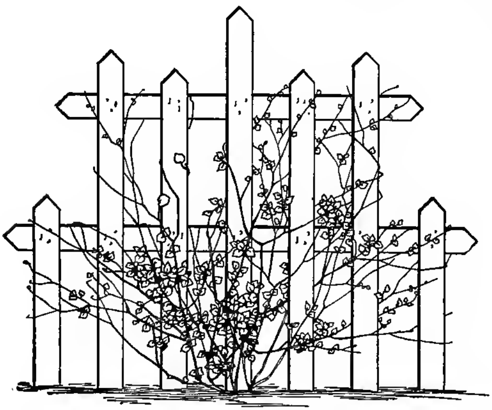


FIG. 593. — A Vine Trellis.

training them, guiding the little fingers so each vine will spread over to the adjoining strings, the spaces may be completely interlaced, and by the time the top of the umbrella frame has been reached you will have a thickly covered bower.

A Small Trellis for a climbing rose, or other vine, may be made of laths fastened together in the manner shown in Fig. 593. The laths may be nailed together with brads (Fig. 594); or the edges may be notched as shown in Fig. 595, to receive lashings of cord put on as shown in Fig. 596.

FIG. 595.

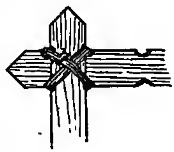


FIG. 596.

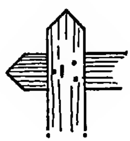


FIG. 594.

FIGS. 594–596.—Two Ways of Fastening Trellis Together.

A Trellis for Sweet Peas should be covered with wire-mesh, and Fig. 597 shows a simple framework to tack the wire to. This framework should be made of strips at least 1½ inches square, and the corners and the upright pieces should be braced as shown in the drawing.

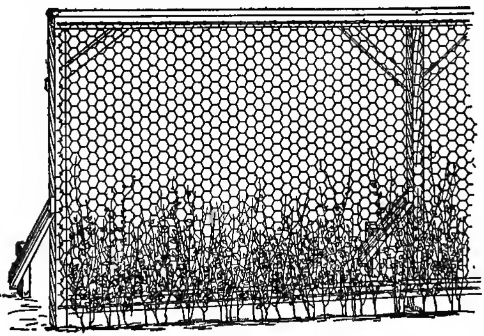


FIG. 597.—Trellis for Sweet Peas.

Wire-mesh can be had with *mesh* of a number of sizes (the meshes are the openings), the three com-

mon sizes being 1 inch, 1½ inches, and 2 inches, and it comes in various widths running from 1 foot to 6 feet. The wire should be stretched as tight as possible, to make a neat appearing job, and should be tacked in place with small staples.

Flower-Boxes are easy to make, and your mother and possibly some of the neighbors will give you orders for boxes for their windows, if you let them know that you can make them. And incidentally I might say that this is a good way for a handy boy to earn money, as there is always a demand for well-made boxes.

Fig. 598.

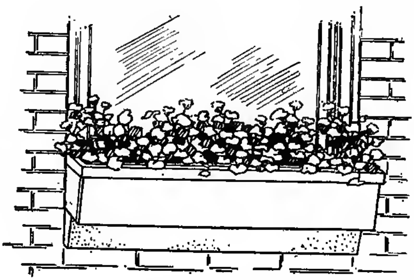


Fig. 599.

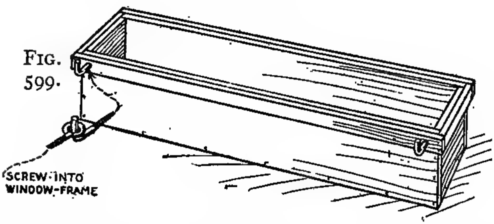


Fig. 598. — A Window Flower-Box.
Fig. 599. — Detail of Box and Method of Anchoring It to a Window-Frame.

The only difference between the construction of

A Window Flower-Box similar to that shown in Figs. 598 and 599, and a grocery box is that the bottom of the flower-box is fitted between the sides and ends, instead of nailed to the bottom edges, and a narrow strip is nailed around the top edges. It is the

narrow top band which gives a flower-box a pleasing style.

Eight inches is a good width, 6 inches is plenty deep, and the length should be such that the box will extend along the entire length of the window-sill.

A simple method of anchoring the box in position is shown in Fig. 599. Screw a screw-hook into the top band of the box, on the back, near each end, and screw a screw-eye into the window-frame, at each side, in the proper position to receive each screw-hook. Care must be taken to set the flower-box far enough out on the sill so it will not interfere with the raising of the window-screen.

FIG. 602.

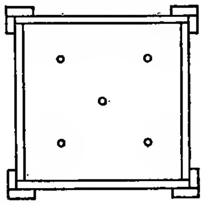


FIG. 601.

FIG. 600.

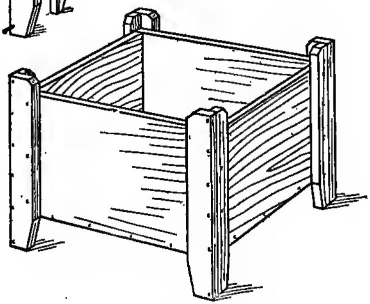


FIG. 600. — A Plant Box.
FIG. 601. — The Corner Strips.
FIG. 602. — Plan of Box.

Bore drain-holes through the bottom of the box, providing a hole for about every 6 square inches of bottom surface. The holes should be about ½ inch in diameter.

Painting the Flower-Box. A dark shade of green always looks well upon flower-boxes, although it is sometimes thought best to paint them the same color as the house trimmings. You

can use your own judgment about this. Drive all nail-heads below the surface of the wood, and putty the holes before applying the paint.

The Plant-Box shown in Fig. 600 may be made out of a soap-box, but you will have a neater appearing job if you build the box yourself, fitting the bottom boards between the sides. Figure 601 shows how the corner strips should be prepared and fastened together. Make them long enough so the tops will project 1 inch above the top of the box, and the lower ends about 2 inches below the bottom. The upper corners of the strips can be cut off by means of a chisel. In fastening the corner strips in place, be careful to make the lower projections equal. Figure 602 shows a plan of the box, and a good arrangement for spacing the drain-holes.

INDEX

D

E

I

J

K

N

O

P

R

S

T